

DESCRIPTION

IMAGE, RECORDING METHOD, INFORMATION RECOGNITION
METHOD, AND INFORMATION RECOGNITION SYSTEM

5

Technical Field

The present invention relates to an image, a recording method, an information recognition method, and an information recognition system. More
10 specifically, the present invention relates to an image, a recording method, an information recognition method, and an information recognition system that enable easy an authenticity judgment of a genuine product with respect to a product produced by forgery,
15 alteration, or a fraudulent method.

Background Art

Various propositions have been made in recent years in order to prevent imitation, copying, and the
20 like of various prints and printed paper typified by stocks and cards. For example, Patent Documents 1 to 4 each propose a print using ink containing a colorless pigment which cannot be observed under ordinary light and is excited with ultraviolet light
25 to emit visible light. Patent Document 5 proposes a composition which is excited with infrared light to emit infrared light. Patent Documents 6 and 7 each

propose a print and an image display body each using a fluorescent agent that emits visible light with infrared rays. In each of those propositions, information is formed by sequentially laminating
5 colorant layers for respective colors on recording paper or a recording medium. When one tries to record a large amount of information according to such a mode, the number of laminated colorant layers increases, so the print or the recording medium has
10 an increased thickness. In addition, in the recording medium or the print in which information is composed of a laminate of colorant layers, the respective colorants constituting the information are independent of each other. Therefore, the colorants
15 in the colorant layers can be identified by one who intends to perform forgery or alteration.

-Patent Document 1: Japanese Patent Application Laid-Open No. H10-297075

-Patent Document 2: Japanese Patent Application Laid-
20 Open No. H07-125403

-Patent Document 3: Japanese Utility Model Examined Publication No. H07-83987

-Patent Document 4: Japanese Utility Model Application Laid-open No. Sho 60-187085

25 -Patent Document 5: Japanese Patent Application Laid-Open No. H08-151545

-Patent Document 6: Japanese Patent Application Laid-

Open No. H10-129107

-Patent Document 7: Japanese Patent Application Laid-

Open No. H09-240136

5 Disclosure of Invention

A clear interface generally exists between laminated layers in a laminated configuration of the prior art. Various light beams are refracted at the time of incidence/reflection of light at the
10 interface. It may be difficult to read out a large amount of information accurately if the refraction is not taken into consideration. In addition, the laminated ink layers may be peeled off due to the interface. On the other hand, in the case where an
15 ink layer capable of emitting fluorescence in a visible light region (hereinafter, referred to as "fluorescent ink layer") is used, fluorescent emission cannot be observed if a black ink layer that absorbs all the wavelengths in the visible light
20 region made of carbon black or the like is placed as an upper layer. Therefore, in this case, a fluorescent ink layer is placed on the black ink layer to clarify its presence, or an image on the black ink layer is disturbed. In another method, in
25 order to avoid such a laminated configuration, regional separation of the respective ink layers on the surface of the recording medium and the stencil

printing of them must be performed.

Therefore, a first object of the present invention is to obtain an image and a judgment method in each of which, in the case where a fluorescent ink layer uses its fluorescent emission property as judgment means, the layer can ensure its fluorescent emission property even when a fluorescent emission wavelength overlaps the absorption wavelength of a colorant in a laminated ink layer. Another object of the present invention is to keep a recording density of the upper ink layer constant or substantially constant so that the presence of the fluorescent ink layer cannot be observed, preferably to enable an image on the upper ink layer to be clear at that time.

In addition, a second object of the present invention is to provide a novel system that cannot be conventionally obtained, and an image, a recording method, a judgment method, or an information recognition method used for the system by making comprehensive investigations on the relationship between a fluorescent ink layer and an ink layer to be laminated for providing a novel image and a novel judgment method each utilizing fluorescent property as well as a recording method and ink to be used therefor. In addition, a third object of the present invention is to provide an image, a recording method, an information recognition method, and an information

recognition system capable of providing a print or the like which can easily record a large amount of information without laminating a large number of ink layers, and which hardly allows forgery, alteration,
5 or the like.

A fourth object of the present invention is to provide a novel image, a novel recording method, a novel judgment method, or a novel information recognition method capable of showing different
10 images with visual recognition and recognition through optical magnification as image judgment by paying attention to a relative positional relationship between a fluorescent ink layer or a fluorescent particle in it and an ink layer to be
15 laminated or a colored colorant in it. Other objects of the present invention will be understood from the following description.

The present invention is intended to achieve any one of the above objects, and is typified by the
20 following configurations. According to a first aspect of the present invention, there is provided an image, having a laminated portion in which multiple kinds of ink layers are laminated on a recording material, characterized in that: the laminated
25 portion has a colored second ink layer laminated on a first ink layer having fluorescent emission property; and part of the first ink layer is exposed in a

dotted manner with respect to the second ink layer. With this configuration, the presence of a fluorescent emission portion is hardly observed, and density fluctuation in the colored ink layer is
5 prevented, so no conventional inconvenience on an image occurs.

According to a second aspect of the present invention, there is provided an image according to the first aspect of the present invention,
10 characterized in that: the fluorescent emission property is obtained by a fluorescent dispersing element in a first ink for forming the first ink layer; and the average particle size of the fluorescent dispersing element is larger than an
15 average particle size of a colorant in a second ink for forming the second ink layer. According to a third aspect of the present invention, there is provided an image according to the first aspect of the present invention, characterized in that the
20 thickness of the first ink layer is larger than the thickness of the second ink layer. The dotted exposure described above can be formed more effectively by using any one of those characteristics or by combining two or more of them.

25 Examples of a component that makes those effects of the present invention more remarkable include the following configurations: (1) the first

ink layer uses a wavelength outside the visible light wavelength region as excitation energy to emit fluorescence of a specific color in the visible light wavelength region, (2) the wavelength region of an emission spectrum of the first ink layer is in the wavelength region of an absorption spectrum of the second ink layer, (3) the first ink layer contains multiple lanthanoids, and uses infrared wavelength light as excitation energy to emit fluorescence in the visible light wavelength region, (4) the second ink layer is a layer of a black-based color containing carbon black, (5) the image has the first ink layer on which the second ink layer is not laminated in a portion adjacent to the laminated portion, (6) the image has a part of the second ink layer that does not have the first ink layer in a portion adjacent to the laminated portion, and forms information resulting from the second ink layer, (7) the recording material has a transparent layer at least on the second ink layer in the laminated portion and on the dotted exposure portion of the first ink layer, and (8) a thickness of the transparent layer is larger than the total thickness of the ink layers formed on the recording material.

According to a fourth aspect of the present invention, there is provided an image, having a laminated portion in which multiple kinds of ink

layers are laminated on a recording material,
characterized in that: the laminated portion has a
colored second ink layer laminated on a first ink
layer having fluorescent emission property; a part of
5 the first ink layer is exposed in a dotted manner
with respect to the second ink layer; the thickness
of the first ink layer is larger than the thickness
of the second ink layer; and the wavelength region of
an emission spectrum of the first ink layer is in the
10 wavelength region of an absorption spectrum of the
second ink layer. In addition, the recording
material has a transparent layer at least on the
second ink layer in the laminated portion and on the
dotted exposure portion of the first ink layer. The
15 transparent layer has an effect of providing
refraction such that emission of the dotted exposure
portion that causes dotted light emission can be
observed as surface emission or an effect of
smoothing the surface of the image.

20 According to a fifth aspect of the present
invention, there is provided a recording method,
including the steps of: forming a first ink layer of
a first ink having a fluorescent dispersing element
on a recording material; and forming a second ink
25 layer of a second ink having a colorant in such a
manner that a part of the first ink layer is exposed
in a dotted manner with respect to the second ink

layer. According to a sixth aspect of the present invention, there is provided a recording method, including the steps of: forming a first ink layer of a first ink having a fluorescent dispersing element
5 on a recording material; and forming a second ink layer of a second ink having a colorant on the first ink layer, characterized in that the average particle size of the dispersing element dispersed into the first ink is larger than the average particle size of
10 a dispersing element dispersed in the second ink by such an extent that a part of the first ink layer is exposed in a dotted manner with respect to the second ink layer.

According to a seventh aspect of the present
15 invention, there is provided a recording method, including the steps of: forming a first ink layer of a first ink having a fluorescent dispersing element on a recording material; and forming a second ink layer of a second ink having a colorant on the first
20 ink layer, characterized in that the applied thickness of the first ink on the recording material is larger than an applied thickness of the second ink by such an extent that a part of the first ink layer is exposed in a dotted manner with respect to the
25 second ink layer. According to any one of those methods, the image of the present invention can be certainly obtained. Preferable examples of specific

conditions for those methods include: (1) each of the first ink and the second ink is an ink for gravure printing containing an aqueous or oil-based liquid and a film forming material; (2) each of the first
5 ink and the second ink is an ink for offset printing, letterpress printing, or screen printing containing a solvent and an oxidation-polymerizable film forming material; and (3) each of the first ink and the second ink is ink for ultraviolet-curing printing
10 containing a solvent and an oxidation-polymerizable film forming material.

According to an eighth aspect of the present invention, there is provided an information recognition method, including irradiating an image,
15 which has a first ink layer laminated on a recording material and having fluorescent emission property to emit fluorescence of a specific color in the visible light wavelength region by using a wavelength outside the visible light wavelength region as excitation
20 energy and a colored second ink layer laminated on the first ink layer, and in which a part of the first ink layer is exposed in a dotted manner with respect to the second ink layer, with a wavelength outside the visible light wavelength region, to observe
25 fluorescent emission of the first ink layer due to the dotted exposure.

According to a ninth aspect of the present

invention, there is provided an information recognition system for performing an authenticity judgment of a first product that has an image, which has a first ink layer laminated on a recording
5 material and having fluorescent emission property to emit fluorescence of a specific color in the visible light wavelength region by using a wavelength outside the visible light wavelength region as excitation energy and a colored second ink layer laminated on
10 the first ink layer, and in which a part of the first ink layer exposed in a dotted manner with respect to the second ink layer, with respect to a second product that does not have the image, by irradiating the image with a wavelength outside the visible light
15 wavelength region to judge that the first product is a true product on the basis of the presence of fluorescent emission of the first ink layer.

According to a tenth aspect of the present invention, there is provided an ink for forming a
20 first ink layer having fluorescent emission property on which a colored second ink layer is laminated and a part of which is exposed in a dotted manner with respect to the second ink layer, containing a colorant containing multiple lanthanoids. In
25 addition to the tenth aspect of the present invention, it is more preferable that: (1) the ink containing the colorant containing the multiple lanthanoids have

fluorescent emission property to emit fluorescence of a specific color in the visible light wavelength region by using a wavelength outside the visible light wavelength region as excitation energy; (2) the
5 ink containing the colorant containing the multiple lanthanoids be an ultraviolet-curing ink; or (3) the ink containing the colorant containing the multiple lanthanoids be an oil-based ink.

10 Brief Description of Drawings

FIG. 1 is a drawing of an image according to the present invention as viewed from the surface of the image;

FIG. 2 is a cross-sectional drawing of the
15 image of FIG. 1;

FIG. 3 is a drawing showing a state where a colorant used for a first ink layer is fixed onto a recording material; and

FIG. 4 is a drawing showing a state where a
20 transparent coating layer is placed on an outermost surface.

Best Mode for Carrying Out the Invention

Next, the present invention will be described
25 in more detail by way of preferred embodiments.

An image of the present invention is an image formed by overlapping multiple ink layers,

characterized in that: a first ink layer is formed on a recording material by means of a first ink having fluorescent emission property; a second ink layer is formed on the first ink layer by means of a second
5 ink; the first ink layer is exposed in a dotted manner on the second ink layer; and the image is formed by at least one of the first ink layer and the second ink layer. With this characteristic, the optical density of the second ink layer is comparable
10 to that of an image composed of the second ink layer alone, and is sufficient for an image, and the first ink layer cannot be observed. In addition, emission can be observed in the form of a dotted emitting portion when the image is optically magnified at a
15 magnification of 5 to 10, so the emission can be observed in the form of a line-shaped or plane-shaped emitting portion (the following examples without explanations satisfy this condition and provide this effect).

20 FIG. 1 shows an image of the present invention when viewed from a printed surface. In the figure, a portion 1 corresponds to a part of an ink layer formed by means of a first ink. A portion 2 corresponds to an ink layer portion formed by means
25 of a second ink. The part 1 of the first ink layer is exposed in a dotted manner on the second ink layer 2. The dotted exposure defines a relative positional

relationship between a fluorescent ink layer or a fluorescent particle in it and an ink layer to be laminated or a colored colorant in it. Even if the ink layer is laminated, fluorescent emission can be
5 observed in the form of a dotted emitting portion through judgment according to magnification by means of a lens or the like. At the same time, the fluorescent emission can be observed in the form of a line-shaped or plane-shaped emitting portion.

10 In addition, FIG. 2 is a cross-sectional drawing of the image of FIG. 1. In the figure, the portion 1 corresponds to the first ink layer portion. The portion 2 corresponds to the second ink layer portion. In addition, broken lines indicate the
15 thickness of the second ink layer (thickness of a printed coating). Since the thickness of the second ink layer is smaller than that of the first ink layer, the second ink layer is fixed to each gap between bumps of the first ink layer. Therefore, the optical
20 density of the second ink layer (for example, 1.40) is nearly equal to that of the second ink layer alone (for example, 1.43).

In the above description, when the first ink layer is formed by means of an ink that uses infrared
25 wavelength light as excitation energy to emit fluorescence, the image can find use in an increased number of security applications. In addition, when

the first ink layer is formed by means of an ink that uses infrared wavelength light as excitation energy to emit fluorescence in the visible light wavelength region, the image can be recognized with ease. In addition, when the wavelength region of an emission spectrum of the first ink layer is in the wavelength region of an absorption spectrum of the second ink layer, it becomes possible to exploit the characteristics of the image of the present invention. That is, the image, which is hardly recognized with the eyes in ordinary cases owing to a large printed area of the second ink layer, can be observed with a microscope or through irradiation with infrared wavelength light when the first ink layer is formed by means of the above ink. When a colorant of the first ink forming the first ink layer is a pigment, the first ink can be easily exposed in a dotted manner in the second ink layer. The colorant of the first ink is particularly preferably an inorganic pigment.

The colorant of the first ink is also particularly preferably a colorant containing multiple lanthanoids. When a colorant of the second ink forming the second ink layer is a nonfluorescent colorant, fluorescent property of the first ink layer can be easily observed. The colorant of the second ink is preferably a pigment, particularly preferably

an inorganic pigment. In addition, when the colorant of the second ink layer is carbon black, the first ink layer can be easily recognized because the second ink layer absorbs most of the visible light.

5 The recording method of the present invention is a recording method for forming an image by overlapping multiple ink layers, the method including: forming a first ink layer of a first ink having fluorescent emission property on a recording
10 material; and forming a second ink layer of a second ink on the first ink layer so as to have a space.

 The recording method of the present invention is a recording method for forming an image by overlapping multiple ink layers, the method
15 including: forming a first ink layer of a first ink having fluorescent emission property on a recording material; and forming a second ink layer of a second ink on the first ink layer, in which the average particle size of a dispersing element dispersed into
20 the first ink is larger than the average particle size of a dispersing element dispersed into the second ink. The difference in average particle size is preferably such that fluorescent particles have an average particle size of 0.5 μm or more to about 3 μm
25 (preferably 1 μm or more to 2 μm or less, and it is more preferable that particles having an average particle size in this range account for 40% or more

of the first ink), while a colored colorant has an average particle size on the order of 10^{-9} m (nm). Specifically, the fluorescent particles are preferably inorganic pigment particles, and the
5 colored colorant is preferably an organic dye or an organic pigment.

The recording method of the present invention is a recording method for forming an image by overlapping multiple ink layers, the method
10 including: forming a first ink layer of a first ink having fluorescent emission property on a recording material; and forming a second ink layer of a second ink on the first ink layer, in which the thickness of the first ink layer formed on the recording material
15 (thickness of a printed coating) is larger than the thickness of the second ink layer. The ink used for the image formation contains a colorant such as a pigment, and a dispersant for maintaining a state of dispersion of the colorant in a liquid, or a film
20 forming material or binder for fixing the colorant to printing paper (hereinafter, the term "printing paper" also refers to a recording medium) after ink is applied to record information. Examples of the recording medium include: ordinary commercially
25 available recording media such as pulp, fibers, resins, stickers, and corrugated cardboard; and those obtained by subjecting the above recording media to a

coating process for coloring.

The image of the present invention is formed according to any one of various printing modes. For example, as conventionally known, a liquid medium for
5 ink when the image is formed according to an inkjet mode is mainly water or a mixture of water and a water-soluble organic solvent. Examples of a water-soluble liquid medium include: water-soluble alcohols; and water-soluble polyhydric alcohols such
10 as ethylene glycol, propylene glycol, diethylene glycol, triethylene glycol, and glycerin. In addition, in order to maintain the dispersability of a pigment in an aqueous medium, the liquid medium contains any one of pigment dispersants such as
15 various surfactants and water-soluble resins. Representative examples of the water-soluble resins include acrylic resins having a water-soluble group such as a carboxyl group or a quaternary ammonium group.

20 In addition, when the image of the present invention is formed by means of an ink for gravure printing, for example, an aqueous ink for gravure printing, an emulsion composed of water containing a water-soluble organic solvent such as an alcohol, and
25 a water-soluble resin or a water-insoluble resin, or the like is used for the ink. Examples of the resins include acrylic resins, vinyl chloride-vinyl acetate

copolymer resins, ethylene-vinyl acetate copolymer resins, polyester resins, polyamide resins, cellulose-based resins, polyurethane resins, and chlorinated polypropylene resins. The ink further
5 contains a cross-linking agent or the like as required. Examples of an organic solvent when the image is formed by means of an oil-based ink for gravure printing include methyl ethyl ketone, toluene, xylene, cyclohexanone, cyclohexane, and alkyl-
10 substituted cyclohexane. Examples of a film forming material (binder) for the ink include the above water-insoluble resins. The oil-based ink similarly contains a cross-linking agent as required.

In addition, when the image of the present
15 invention is formed through offset printing, letterpress printing, or screen printing, a liquid medium for ink used for each printing contains a petroleum-based solvent and a film forming material having an oxidation-polymerizable double bond such as
20 semi-drying oil, drying oil, a rosin-denatured phenol resin, a petroleum resin, or an alkyd resin. Any one of the above liquid media (varnish and vehicle) for ink is conventionally known, and any one of the other conventionally known liquid media can be used for an
25 ink for forming the image of the present invention. Although liquid media for ink used for representative printing modes have been exemplified above, liquid

media for ink used for the other printing modes are also applicable.

The main characteristic of the present invention is that a fluorescent colorant is used for the first ink as a colorant of ink for any one of the above conventionally known printing modes. The term "fluorescent colorant" refers to a colorant that uses light having a certain wavelength as excitation energy to emit light in a different wavelength region that does not include the wavelength for the excitation. Of such colorants, a pigment having high fastness property is preferable. A dye may be used in combination depending on applications and purposes.

The fluorescent colorant to be used in the present invention, which has fluorescent emission property and is used for ink, generates a spectrum when it is excited with ultraviolet light and then returns to a lower energy level. In addition, a peak of the spectrum is in a wavelength region of blue, green, red, or the like. The colorant is obtained by adding a trace amount of metal (such as copper, silver, manganese, bismuth, or lead) as an activator for intensifying emission to a high-purity fluorescent material such as zinc sulfide or a sulfide of an alkaline earth metal; and sintering the mixture at a high temperature. The hue, brightness, and degree of color attenuation of an ultraviolet

fluorescent pigment can be adjusted in accordance with a combination of a host crystal and an activator.

Specific examples of the fluorescent colorant include $\text{Ca}_2\text{B}_5\text{O}_9\text{Cl}:\text{Eu}^{2+}$, CaWO_4 , $\text{ZnO}:\text{Zn}$, $\text{Zn}_2\text{SiO}_4:\text{Mn}$,
5 $\text{Y}_2\text{O}_2\text{S}:\text{Eu}$, $\text{ZnS}:\text{Ag}$, $\text{YVO}_4:\text{Eu}$, $\text{Y}_2\text{O}_3:\text{Eu}$, $\text{Gd}_2\text{O}_2\text{S}:\text{Tb}$, $\text{La}_2\text{O}_2\text{S}:\text{Tb}$,
 $\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Ce}$, $\text{Sr}_5(\text{PO}_4)_3\text{Cl}:\text{Eu}$, $3(\text{Ba}, \text{Mg})\text{O} \cdot 8\text{Al}_2\text{O}_3:\text{Eu}$,
 $\text{Zn}_2\text{GeO}_4:\text{Mn}$, $\text{Y}(\text{P}, \text{V})\text{O}_4:\text{Eu}$, $0.5\text{MgF}_2 \cdot 3.5\text{MgO} \cdot \text{GeO}_2:\text{Mn}$,
 $\text{ZnS}:\text{Cu}$, and $\text{ZnS}:\text{Mn}$. Each of them is used alone, or
several kinds of them are arbitrarily selected and
10 mixed before use. Fluorescent spectra of those
fluorescent colorants have peaks outside the
wavelength region of blue, green, red, or the like,
and can be appropriately selected in accordance with
a desired fluorescent spectrum.

15 An infrared fluorescent pigment to be used in
the present invention is a pigment which is excited
with infrared light (about 800 to about 1,200 nm) to
emit visible light (about 400 to about 800 nm). The
infrared fluorescent pigment is a fluorescent
20 material having an extremely special excitation
mechanism. Specifically, multiple photons of
infrared light having small energy are used to excite
visible light emission. The excitation mechanism is
classified into two types. One of them, which is
25 observed in many host crystals using Er^{3+} , Ho^{3+} , (rare
earth) and the like as activators, is such that
excitation is performed through multi-stage

excitation in activator ions. The other type is such that Er^{3+} , Tm^{3+} , Ho^{3+} , or the like as an emission center is excited to a higher level through multiple times of transfer of resonance energy from a
5 sensitizer, that is, multi-stage energy transfer resulting from the absorption of infrared rays by a sensitizer Yb^{3+} . Specific examples of the sensitizer include $\text{YF}_3:\text{Yb}+\text{Er}$, $\text{YF}_3:\text{Yb}+\text{Tm}$, and $\text{BaFCl}:\text{Yb}+\text{Er}$.

The nonfluorescent colorant to be used in the
10 present invention is preferably a pigment. Examples of an ordinary pigment include: inorganic pigments such as titanium oxide, zinc white, ultramarine blue, iron blue, chromium oxide, and iron oxide; insoluble azo pigments such as arylides, acetoacetic acid
15 arylide disazo pigments, and pyrazolone azo pigments; soluble azo pigments such as lake red C and brilliant carmine 6B; organic pigments such as copper phthalocyanines, quinacridones, indigo·thioindigo pigments, indanthrones, and perynone·perylene
20 pigments; and various pigments used for conventional printing ink such as carbon black.

In each combination of pigments, the ordinary pigment to be used is preferably a pigment having a slight or no absorption in the infrared portion and
25 the ultraviolet portion. For example, when a black pigment that absorbs light over an entire wavelength region is used, it is preferably used at a low

concentration (less than 1 mass%). In addition, either of the above pigments is preferably used in combination with a pigment that reflects light over an entire wavelength region such as a white pigment.

5 The use of the white pigment efficiently improves the emission of the ultraviolet fluorescent pigment and/or the infrared fluorescent pigment without allowing ultraviolet light and/or infrared light with which the printed layer is irradiated to pass through

10 the printing paper. In addition, a colored ordinary pigment to be used is preferably a pigment having a hue different from the emission wavelength of the ultraviolet fluorescent pigment and/or the infrared fluorescent pigment. In such a combination,

15 irradiation of a print with ultraviolet light and/or infrared light provides an observer with a significantly different visual appreciation. As a result, a large amount of information can be recorded, the forgery, alteration, and falsification of

20 information become difficult, and a false product can be easily detected.

The ink to be used in the present invention can be obtained by mixing required components and dispersing a pigment into a liquid medium according

25 to a production method adapted to its printing mode. The ultraviolet fluorescent pigment and the infrared fluorescent pigment easily sediment in ink because of

its large specific gravity. Therefore, they are preferably subjected to a re-dispersion treatment before use. Although a printing method by means of the ink to be used in the present invention is not particularly limited, specifically, the ink is
5 suitable for inkjet recording, gravure printing, offset printing, letterpress printing, screen printing, or the like.

Examples of the printing paper (recording
10 medium) include: securities, bills, gift certificates, cards, train tickets, admission tickets, and the like; synthetic paper; and plastic films. The examples further include a commodity itself which is easily imitated, and a case or corrugated cardboard
15 box for the commodity, so the printing paper is not particularly limited. Printing on the printing paper (recording medium) may be such that various images (information) are recorded by means of the above ink alone, or may be such that a specific image is formed
20 on part of an ordinary print according to the method of the present invention. For example, securities may be formed by means of ordinary printing ink, and only part of its image may be formed according to the method of the present invention. A fluorescent
25 pigment is relatively expensive. A problem associated with cost can be avoided by printing a part of an image, for example, part of a large number

of letters to be printed with the method of the present invention.

Next, an example of the recording method of the present invention will be described with reference to
5 the drawings.

FIG. 1 shows an image of the present invention when viewed from its surface. In the figure, a portion 1 corresponds to a portion in which a first ink layer is formed. A portion 2 corresponds to a
10 portion to which a second ink layer is formed. Part of the first ink layer is exposed in a dotted manner on the surface of the second ink layer.

FIG. 2 is a cross-sectional drawing of the image of FIG. 1. In the figure, a region 1
15 corresponds to the portion to which the first ink layer is formed. A region 2 corresponds to the portion to which the second ink layer is formed. In addition, broken lines indicate the thickness of the second ink layer (thickness of a printed coating).
20 Since the thickness of the second ink layer is smaller than that of the first ink layer, the second ink layer is fixed to each gap between bumps of the first ink layer.

FIG. 3 shows a state where a colorant used for
25 the first ink layer is fixed onto a recording material. In the figure, a portion 1 corresponds to the first ink layer portion. A portion 2 corresponds

to the second ink layer portion. In addition, broken lines indicate the thickness of the second ink layer. The second ink layer is fixed to each gap between bumps of the first ink layer.

5 FIG. 4 shows a state where a transparent coating layer 3 is placed on an outermost surface. When the transparent coating layer is placed on the outermost surface, the irregularities on the image surface are suppressed, whereby the print quality of
10 the image becomes satisfactory. In this case, when a film-shaped layer is used as the transparent coating layer, a large number of fine air bubbles that cannot be normally observed can be generated between the image surface and the film. As a result, it becomes
15 difficult to judge the state of a printed portion from the image surface, which is preferable for an image for which security is demanded.

In addition, the use of the above recording method results in the formation of a good image,
20 wherein a second ink layer is formed by means of a second ink on a first ink layer formed by means of a first ink having fluorescent emission property on a recording material with the second ink layer being exposed in a dotted manner on the first ink layer.

25 The present invention also provides an information recognition method characterized by including irradiating the image described above with

ultraviolet light and/or infrared light to recognize information, and an information recognition system characterized by including the above-described image, a light source for irradiating the image with

5 ultraviolet light and/or infrared light, and means for recognizing a hue generated by the irradiation using the light source. The present invention provides an image formed by overlapping multiple ink layers, comprising a first ink layer formed on a

10 recording material by means of a first ink having fluorescent emission property and a second ink layer formed on the first ink layer by means of a second ink wherein the first ink layer is exposed in a

15 dotted manner on the second ink layer, and the image is formed by at least one of the first ink layer and the second ink layer. In addition, the present invention provides an image formed by overlapping multiple ink layers, comprising a first ink layer formed on a recording material by means of a first

20 ink having fluorescent emission property and a second ink layer formed on the first ink layer by means of a second ink, wherein the first ink layer is exposed in a dotted manner on the second ink layer, the image being formed by at least one of the first ink layer

25 and the second ink layer, and the thickness of the first image on the recording material is larger than the thickness of the second image.

In addition, the present invention provides an image formed by overlapping multiple ink layers, comprising a first ink layer formed on a recording material by means of a first ink having fluorescent
5 emission property and a second ink layer formed on the first ink layer by means of a second ink, wherein the first ink layer is exposed in a dotted manner on the second ink layer, the image is formed by at least one of the first ink layer and the second ink layer,
10 and a transparent layer is formed on an outermost surface of the image formed by overlapping the multiple ink layers on the recording material.

In addition, the present invention provides a recording method for forming an image by overlapping
15 multiple ink layers, the method including the steps of forming a first ink layer of a first ink having fluorescent emission property on a recording material and forming a second ink layer of second ink on the first ink layer, wherein the image is formed by at
20 least one of the first ink layer and the second ink layer, and the second ink layer is so formed as to have a space. In addition, the present invention provides a recording method for forming an image by overlapping multiple ink layers, comprising the steps
25 of forming a first ink layer of a first ink having fluorescent emission property on a recording material and forming a second ink layer of a second ink on the

first ink layer, wherein the image is formed by at least one of the first ink layer and the second ink layer, and the average particle size of dispersing elements dispersed in the first ink is larger than
5 the average particle size of dispersing elements dispersed in the second ink.

In addition, the present invention provides a recording method for forming an image by overlapping multiple ink layers, the method comprising the steps
10 of forming a first ink layer of a first ink having fluorescent emission property on a recording material and forming a second ink layer of a second ink on the first ink layer, wherein the image is formed by at least one of the first ink layer and the second ink
15 layer, and the applied thickness of the first ink on the recording material is larger than the applied thickness of the second ink. In addition, the present invention provides an information recognition method, including irradiating an image formed by
20 overlapping multiple ink layers with ultraviolet light and/or infrared light to recognize image information, the image having a first ink layer formed by means of a first ink having fluorescent emission property on a recording material and a
25 second ink layer formed by means of a second ink on the first ink layer, wherein the first ink layer is exposed in a dotted manner on the second ink layer,

and the image is formed by at least one of the first ink layer and the second ink layer. In addition, the present invention provides an information recognition system comprising an image formed by overlapping
5 multiple ink layers, the image having a first ink layer formed by means of a first ink having fluorescent emission property on a recording material and a second ink layer formed by means of a second ink on the first ink layer, the first ink layer being
10 exposed in a dotted manner on the second ink layer, the image being formed by at least one of the first ink layer and the second ink layer; a light source for irradiating the image with ultraviolet light and/or infrared light; and means for recognizing a
15 hue generated by the irradiation using the light source.

Examples

Next, the present invention will be described in more detail by way of examples. Unless otherwise
20 stated, the terms "part" and "%" in the following description mean "part by mass" and "mass%", respectively.

(Example 1)

A styrene-acrylic acid copolymer (having a
25 weight average molecular weight of about 7,000 and an acid value of about 200), a predetermined amount of potassium hydroxide necessary for neutralizing the

copolymer, and water were stirred and mixed while the temperature of the mixture was kept at about 60°C, to thereby prepare a 10% aqueous solution of the styrene-acrylic acid copolymer. The aqueous solution
 5 of the styrene-acrylic acid copolymer thus prepared was used as a dispersant to prepare a pigment dispersion element having the following composition.

	10% aqueous solution of styrene-acrylic acid copolymer	20 parts
10	Infrared fluorescent pigment (YF ₃ :Yb:Er)	3 parts
	C.I. Pigment Yellow 138	7 parts
	Glycerin	20 parts
	Diethylene glycol	20 parts
15	Triethylene glycol	10 parts
	Water	20 parts

Those materials were fed into a batch-type vertical sand mill. Glass beads having a diameter of 1 mm were loaded as media into the mill, and the
 20 whole was subjected to a dispersion treatment for 3 hours while being cooled with water. The resultant pigment dispersion was subjected to a first centrifugal separation treatment (10,000 rpm, 30 minutes) to remove coarse particles, and then the
 25 resultant was diluted with water by a factor of 2 to prepare an ink. Furthermore, the ink was subjected to a second centrifugal separation treatment (10,000

rpm, 30 minutes) to remove coarse particles, and then the resultant was diluted with a liquid medium to provide a predetermined composition. Thus, an ink for inkjet recording to be used in the present
5 invention was prepared. On the other hand, an ink for inkjet recording was prepared in the same manner as that described above except that only a yellow pigment (7 parts) was used and no infrared fluorescent pigment was used in the above ink
10 composition.

A solid image was printed on plain paper by using the ink containing no infrared fluorescent pigment and a BJJF600 printer (manufactured by Canon Inc.). Then, the letters "AB" (preferably the
15 trademark or logomark of a manufacturer for an authenticity judgment) were printed on the solid image by using the ink containing the infrared fluorescent pigment. Although the printed product presented a uniform yellow color under daylight, the
20 letters "AB" were clearly observed when the printed product was irradiated with infrared ray of 800 to 1,200 nm in a dark room. The letters "AB" were also clearly observed when the printed product was
25 that described above under daylight.

(Example 2)

The following components were fed into a batch-

type vertical sand mill. Glass beads having a diameter of 1 mm were loaded as media into the mill, and the whole was subjected to a dispersion treatment for 3 hours while being cooled with water. Thus, ink
 5 for gravure printing to be used in the present invention was prepared. The ink was nearly free of staining, and presented a white color.

	White pigment (titanium oxide)	2 parts
	Infrared fluorescent pigment (YF ₃ :Yb:Er)	
10		9 parts
	Ultraviolet fluorescent pigment (ZnS:Cu)	
		9 parts
	Methyl ethyl ketone	50 parts
	Toluene	50 parts
15	Acrylic resin	30 parts

The letters "genuine product" were printed on part of woodfree paper by using the ink. Then, a scenic image was printed on the letters by using ordinary inks for four-color gravure printing.
 20 Although only the scenic image was observed under daylight, the letters "genuine product" were clearly observed when the scenic image was irradiated with infrared ray of 800 to 1,200 nm in a dark room. In addition, the letters "genuine product" appeared in
 25 the scenic image when the scenic image was irradiated with infrared rays in the same manner as that described above under daylight.

(Example 3)

The following components were fed into a batch-type vertical sand mill. Glass beads having a diameter of 1 mm were loaded as media into the mill, and the whole was subjected to a dispersion treatment for 3 hours while being cooled with water. Thus, Ink 1 for gravure printing to be used in the present invention was prepared. The ink presented a red color.

10 Composition of Ink 1

Infrared fluorescent pigment ($\text{YF}_3\text{:Yb:Er}$)

10 parts

C.I. Pigment Red 122

10 parts

Methyl ethyl ketone

50 parts

15 Toluene

50 parts

Acrylic resin

30 parts

Separately, Ink 2 and Ink 3 for gravure printing having the following compositions were prepared in the same manner as that described above.

20 Composition of Ink 2

C.I. Pigment Red 122

10 parts

Methyl ethyl ketone

50 parts

Toluene

50 parts

Acrylic resin

30 parts

25 Composition of Ink 3

Infrared fluorescent pigment ($\text{YF}_3\text{:Yb:Er}$)

10 parts

Methyl ethyl ketone	50 parts
Toluene	50 parts
Acrylic resin	30 parts

A solid image 1 was formed on a polyester film
5 by using Ink 1 described above. Then, solid images 2
and 3 were formed on the polyester film by
overprinting Ink 2 and Ink 3 described above in the
order of Ink 2 → Ink 3 and Ink 3 → Ink 2 in such a
manner that the pigment concentrations would be the
10 same. The images 1 to 3 were observed under daylight
or while being irradiated with infrared ray of 800 to
1,200 nm under daylight. As a result, the image 1
was most clearly observed in any case.

(Example 4)

15 The following components were fed into a batch-
type vertical sand mill. Glass beads having a
diameter of 1 mm were loaded as media into the mill,
and the whole was subjected to a dispersion treatment
for 3 hours while being cooled with water. Thus, Ink
20 1 for gravure printing to be used in the present
invention was prepared. The ink presented a red
color.

Composition of Ink 1

25	Ultraviolet fluorescent pigment (Flurol BK)	10 parts
	C.I. Pigment Red 122	10 parts
	Methyl ethyl ketone	50 parts

Toluene	50 parts
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Acrylic resin	30 parts
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Separately, Ink 2 and Ink 3 for gravure printing having the following compositions were prepared in the same manner as that described above.

Composition of Ink 2

C.I. Pigment Red 122	10 parts
Methyl ethyl ketone	50 parts
Toluene	50 parts
Acrylic resin	30 parts

Composition of Ink 3

Ultraviolet fluorescent pigment (Flurol BK)	10 parts
Methyl ethyl ketone	50 parts
Toluene	50 parts
Acrylic resin	30 parts

A solid image 1 was formed on a polypropylene film by using Ink 1 described above. Then, solid images 2 and 3 were formed on the polypropylene film by overprinting Ink 2 and Ink 3 described above in the order of Ink 2 → Ink 3 and Ink 3 → Ink 2 in such a manner that the pigment concentrations would be the same. The images 1 to 3 were observed under daylight or while being irradiated with black light rays under daylight. As a result, the image 1 was most clearly observed in any case.

(Example 5)

The following resin and oil were dissolved into the following solvent at 220°C under nitrogen, and the resultant solution was stirred under heating for 1 hour to prepare varnish.

5	Rosin-denatured phenol resin	40 parts
	Soybean oil	25 parts
	Petroleum-based solvent (AF Solvent 4)	35 parts

The following pigment mixture was added to the varnish prepared as described above in such a manner that the pigment concentration would be 20%. Then, the mixture was evenly kneaded by using a sand mill to prepare an ink for offset printing to be used in the present invention.

15	C.I. Pigment Red 122	10 parts
	Infrared fluorescent pigment (YF ₃ :Yb:Er)	10 parts

On the other hand, an ink for offset printing was prepared in the same manner as that described above except that only the red pigment (10 parts) was used and no infrared fluorescent pigment was used in the above ink composition.

Ciphered letters were printed on plain paper by an offset printing machine by using the above ink containing the infrared fluorescent pigment. Subsequently, a solid image for covering the entire ciphered letters was printed by using the above ink

containing no infrared fluorescent pigment. Although the entire surface of the printed product presented a uniform red color under daylight, only the ciphered letters were clearly observed when the printed

5 product was irradiated with infrared ray of 800 to 1,200 nm in a dark room. The ciphered letters were also clearly observed when the printed product was irradiated with infrared rays in the same manner as that described above under daylight. The ink for

10 offset printing can also be used for letterpress printing or screen printing.

In addition, information recorded on the printed product obtained by using the ink of Example 5 was read by using a scanner having a device for

15 applying specific infrared light adapted to the infrared fluorescent pigment and a device for reading emission information (cipher). As a result, the information was satisfactorily read. Furthermore, information recorded on a printed product formed on

20 the surface of a recording medium by using the ink of Example 5 while varying the thickness of an infrared light absorption portion was read by using a scanner having a device for applying specific infrared light with an excitation wavelength adapted to the infrared

25 fluorescent pigment and a device for reading emission information. As a result, information corresponding to the change in thickness of the infrared light

absorption portion was read.

(Example 6)

The following components were sufficiently mixed and dispersed by using a three-roll machine to
5 prepare an ultraviolet-curing ink.

Composition of Ink 1

	Infrared fluorescent pigment (YF ₃ :Yb:Er/average particle size: 2 μm)	50 parts
	Polyester acrylate	30 parts
10	Hydroxyethyl methacrylate	13 parts
	Hydroxymethyl propiophenone	7 parts

Composition of Ink 2

	Carbon black (average particle size: 500 nm)	20 parts
15	Polyester acrylate	45 parts
	Hydroxyethyl methacrylate	25 parts
	Hydroxymethyl propiophenone	10 parts

Letters were printed on Yupo paper by using Ink 1 described above, and were irradiated with UV light
20 to form an image 1. Furthermore, a solid image was sequentially formed by using Ink 2 in such a manner that the solid image would overlap with a part of the image 1 and a printed thickness of Ink 2 would be smaller than that of Ink 1. After that, the
25 resultant was irradiated with UV light to form an image 2, thereby obtaining a final image 3. When the final image 3 was observed under daylight, only the

black solid image 2 was observed. When the image 3 was irradiated with infrared light of 800 to 1,000 nm in a dark room, the image 1 including the portion overlapping with the image 2 was observed.

5 A transparent laminated film having a thickness larger than the total applied thickness of Ink 1 and Ink 2 was laminated on the image 3 obtained as described above. After that, the resultant was irradiated with infrared light of 800 to 1,000 nm in
10 a dark room. As a result, the image 1 including the portion overlapping with the image 2 was clearly observed. In particular, there was no difference between the portion of the image 2 overlapping with the image 1 and the portion of the image 2 not
15 overlapping with the image 1 as compared to the case before the lamination of the transparent laminated film.

(Example 7)

 The portion where the image 1 and the image 2
20 overlapped with each other in the final image 3 of Example 6 was observed with a microscope at a magnification of "× 10". As a result, Ink 2 used for forming the image 2 was observed being dotted on the portion where the image 1 was printed. Furthermore,
25 the portion was irradiated with infrared light of 800 to 1,000 nm in a dark room. As a result, the image 1 formed by means of Ink 1 was observed being dotted in

the image 2 formed by means of Ink 2.

As described above, according to the present invention, there can be provide an image, a recording method, a recognition method, and an information
5 recognition system with which a large amount of information can be easily recorded without the lamination of a large number of colorant layers, and which hardly allow forgery, alteration, or the like.

As described above, according to the present
10 invention, a relative positional relationship between a large number of fluorescent ink layers or a fluorescent particle in it and an ink layer to be laminated or a colored colorant in it can be clarified. As a result, even if the ink layer is
15 laminated, fluorescent emission can be observed in the form of a dotted emitting portion through judgment according to magnification by means of a lens or the like, or in the form of a line-shaped or plane-shaped emitting portion with the eyes.

20 Therefore, there can be provide an image, a recording method, a recognition method, and an information recognition system with which a large amount of information can be easily recorded, and which hardly allow forgery, alteration, or the like.

This application claims priority from Japanese Patent Application No. 2003-413563 filed December 11, 2003, which is hereby incorporated by reference herein.

CLAIMS

1. An image, comprising a laminated portion in which a plurality of ink layers are laminated on a recording material, wherein the laminated portion has a colored second ink layer laminated on a first ink layer having fluorescent emission property, part of the first ink layer is exposed in a dotted manner with respect to the second ink layer, the thickness of the second ink layer is smaller than that of the first ink layer, and the second ink layer is fixed to each gap between bumps of the first ink layer.

2. An image according to claim 1, wherein the fluorescent emission property is obtained by a fluorescent dispersing Element in first ink for forming the first ink layer, and an average particle size of the fluorescent dispersing element is larger than an average particle size of a colorant in a second ink for forming the second ink layer.

3. An image according to claim 1, wherein the first ink layer contains a fluorescent pigment as a colorant.

4. An image according to claim 1 or 2, wherein a thickness of the first ink layer is larger than a thickness of the second ink layer.

5. An image according to claim 1 or 2, wherein the first ink layer uses a wavelength outside a visible light wavelength region as excitation energy to emit fluorescence of a specific color in the visible light wavelength region.

6. An image according to claim 5, wherein a wavelength region of an emission spectrum of the first ink layer is in a wavelength region of an absorption spectrum of the second ink layer.

7. An image according to claim 5, wherein the first ink layer contains multiple lanthanoids, and uses infrared wavelength light as excitation energy to emit fluorescence in the visible light wavelength region.

8. An image according to claim 7, wherein the second ink layer comprises a layer of a black-based color containing carbon black.

9. An image according to claim 1, wherein the image has the first ink layer on which the second ink layer is not laminated in a portion adjacent to the laminated portion.

10. An image according to claim 1 or 9, wherein the image has a part of the second ink layer that does not have the first ink layer in a portion adjacent to the laminated portion, and forms information resulting from the second ink layer.

11. An image according to claim 1 or 2, wherein the recording material has a transparent layer at least on the second ink layer in the laminated portion and on a dotted exposure portion of the first ink layer.

12. An image according to claim 11, wherein a thickness of the transparent layer is larger than a total thickness of the ink layers formed on the recording material.

13. An image, comprising a laminated portion in which a plurality of ink layers are laminated on a recording material, wherein:

the laminated portion has a colored second ink layer

laminated or a first ink layer having fluorescent emission property;

a part of the first ink layer is exposed in a dotted manner with respect to the second ink layer;

a thickness of the first ink layer is larger than a thickness of the second ink layer;

a wavelength region of an emission spectrum of the first ink layer is in a wavelength region of an absorption spectrum of the second ink layer;

the thickness of the second ink layer is smaller than that of the first ink layer; and

the second ink layer is fixed to each gap between bumps of the first ink layer.

14. An image according to claim 13, wherein the recording material has a transparent layer at least on the second ink layer in the laminated portion and on a dotted exposure portion of the first ink layer.

15. An image according to claim 13, wherein the first ink layer contains a fluorescent pigment as a colorant.

16. A recording method, comprising the steps of:
forming a first ink layer of a first ink having a fluorescent dispersing element on a recording material; and
forming a second ink layer of a second ink having a colorant in such a manner that a part of the first ink layer is exposed in a dotted manner with respect to the second ink layer,

wherein the thickness of the second ink layer is smaller than that of the first ink layer, and the second ink layer is fixed to each gap between bumps of the first ink layer.

17. A recording method, comprising the steps of:
forming a first ink layer of a first ink having a fluorescent dispersing element on a recording material; and
forming a second ink layer of a second ink having a colorant on the first ink layer,

wherein an average particle size of the dispersing element dispersed into the first ink is larger than an average particle size of a dispersing element dispersed in the second ink by such an extent that a part of the first ink layer is exposed in a dotted manner with respect to the second ink layer, the thickness of the second ink layer is smaller than that of the first ink layer, and the second ink layer is fixed to each gap between bumps of the first ink layer.

18. A recording method, comprising the steps of:
forming a first ink layer of a first ink having a fluorescent dispersing element on a recording material; and
forming a second ink layer of a second ink having a colorant on the first ink layer,

wherein an applied thickness of the first ink on the recording material is larger than an applied thickness of the second ink by such an extent that a part of the first ink layer is exposed in a dotted manner with respect to the second ink layer, the thickness of the second ink layer is smaller than that of the first ink layer, and the second ink layer is fixed to each gap between bumps of the first ink layer.

19. A recording method according to any one of claims 16 to 18, wherein each of the first ink and the second ink comprises an ink for gravure printing containing an aqueous liquid or an oil-based liquid and a film forming material.

20. A recording method according to any one of claims 16 to 18, wherein each of the first ink and the second ink comprises an ink for offset printing, letterpress printing, or screen printing containing a solvent and an oxidationpolymerizable film forming material.

21. A recording method according to any one of claims 16 to 18, wherein each of the first ink and the second ink comprises an ink for ultraviolet-curing printing containing a solvent and an oxidation-polymerizable film forming material.

22. A recording method according to any one of claims 16 to 18, wherein each of the first ink layer contains a fluorescent pigment as a colorant.

23. An information recognition method, comprising irradiating an image, which has a first ink layer laminated on a recording material and having fluorescent emission property to emit fluorescence of a specific color in a visible light wavelength region by using a wavelength outside the visible light wavelength region as excitation energy and a colored second ink layer laminated on the first ink layer, and in which a part of the first ink layer is exposed in a dotted manner with respect to the second ink layer, with a wavelength outside the visible light wavelength region, to observe fluorescent emission of the first ink layer due to a dotted exposure of the first ink layer, wherein the thickness of the second ink layer is smaller than that of the first ink layer, and the second ink layer is fixed to each gap between bumps of the first ink layer.

24. An information recognition method according to claim 23, wherein the first ink layer contains a fluorescent

pigment as a colorant.

25. An information recognition system for performing an authenticity judgment of a first product that has an image, which has a first ink layer laminated on a recording material and having fluorescent emission property to emit fluorescence of a specific color in a visible light wavelength region by using a wavelength outside the visible light wavelength region as excitation energy and a colored second ink layer laminated on the first ink layer, and in which a part of the first ink layer is exposed in a dotted manner with respect to the second ink layer, with respect to a second product that does not have the image, by irradiating the image with a wavelength outside the visible light wavelength region to judge that the first product is a true product based on a presence of fluorescent emission of the first ink layer, wherein the thickness of the second ink layer is smaller than that of the first ink layer, and the second ink layer is fixed to each gap between bumps of the first ink layer.

26. An information recognition system according to claim 25, wherein the first ink layer contains a fluorescent pigment as a colorant.

27. An ink for forming a first ink layer having fluorescent emission property on which a colored second ink layer is laminated and a part of which is exposed in a dotted manner with respect to the second ink layer, comprising a colorant containing a plurality of lanthanoids, wherein the thickness of the second ink layer is smaller than that of the first ink layer, and the second ink layer is fixed to each gap between bumps of the first ink layer.

28. An ink according to claim 27, wherein the ink comprising the colorant containing the plurality of lanthanoids has fluorescent emission property to emit fluorescence of a specific color in a visible light wavelength region by using a wavelength outside the visible light wavelength region as excitation energy.

29. An ink according to claim 27, wherein the ink comprising the colorant containing the plurality of lanthanoids comprises an ultraviolet-curing ink.

30. An ink according to claim 27, wherein the ink comprising the colorant containing the plurality of lanthanoids comprises an oil-based ink.

31. An ink according to claim 27, wherein the first ink layer contains a fluorescent pigment as a colorant.