

RECORDING MEMBER AND RECORDING METHOD USING THE SAME

BACKGROUND OF THE INVENTION5 Field of the Invention

This invention relates to a recording member to be used for recording with an ink, and more particularly to a recording member which is particularly suitable for recording of images which are observed by projection
10 on a screen by means of an optical instrument such as OHP (overhead projector) utilizing the transmitted light through the recorded image and further suitable for ink-jet recording.

This invention also relates to a method for
15 effecting recording by use of an ink on a light-transmissive recording member, and more particularly to a method capable of recording an image, which is clear and good in resolution, and can be used for uses utilizing the transmitted light through the image, according
20 to smooth recording operations without contamination of the ink-receiving layer.

Description of the Prior Art

Recording systems with the use of a recording liquid (ink) may include generally, for example, fountain
25 pens, aqueous ball pens, felt pens, etc. and further, as the recording systems attracting attention in these days, the ink-jet recording system in which small droplets

- 1 are generated by various kinds of actuating principles and attached onto a recording member to effect recording thereon.

The ink-jet recording system is characterized by small generation of noise during recording and capability of high speed recording and multi-color recording.

In such a recording system, from aspects of safety and recording aptitude, aqueous inks have primarily been employed.

- 10 As the recording member to be used for such a recording system as mentioned above, conventional papers have heretofore been employed. Whereas, for the recording member to be used for an ink-jet recording system, higher characteristics are coming to be demanded with improvement of performance of the ink-jet recording device enabling high speed recording or multi-color recording.

Thus, for obtaining recorded images of high resolution and high quality, the recording member to be used for ink-jet recording system is required to satisfy the requisite performances as shown below.

- 1) To be as rapid as possible in absorption and fixing of ink.

- 2) When ink dots are overlapped, the ink attached later should not be flown out into the ink dot previously attached.

- 3) The shape of ink dot should be approximate true

1 sphere, and its peripheral should be smooth.

4) The density of ink dot should be high, without obscurity around the dot.

5) The color forming characteristic of ink should
5 be excellent.

Thus, recorded images by ink-jet recording have been employed for observation of surface images on one hand, while a recording member is now demanded, which can utilize the recorded images by ink-jet recording for uses
10 other than surface image observation, on the other.

The uses other than surface image observation may include those in which recorded images are projected by means of optical instruments such as slides or OHP (overhead projector) on a screen, etc. for observation,
15 contact printer, photomask of print substrate, color separating plate during preparation of posi-plate for color printing, CMF (color mosaic filter) for color display of liquid crystal, etc.

While the diffused light of a recorded image is
20 primarily observed when the recorded image is to be used for surface image observation, the transmitted light passing through the recorded image is primarily observed or utilized for various kinds of uses in a recording member to be used in these uses. Accordingly, the recording
25 member to be used for these uses is required to be satisfactorily excellent in light transmitting characteristic in addition to the performance as described above.

1 In the prior art, as the recording member to be used for
uses as mentioned above, there have been known recording
members, comprising a light-transmissive substrate and
an ink acceptor provided on said substrate, having
5 especially excellent light transmittance and ink absorp-
tion property among the requisite characteristics as pre-
viously mentioned.

For the material forming the ink acceptor in such
a recording member, various materials have been employed.
10 In view of the relationship with the aqueous ink employed
as mentioned above, hydrophilic materials such as poly-
amide, polyvinyl alcohol are attracting attention as the
material which can impart excellent ink absorbability
to the ink acceptor.

15 Whereas, when an ink acceptor is formed of a
material having hydrophilic property as mentioned above,
moisture in the air will also be absorbed to make the
material disadvantageously sticky, whereby dust, etc.
will readily be attached onto the surface of the recording
20 member. Further, various inconveniences have been observed,
such as sticking (blocking) between recording members
when stocked in a pile, attachment of fingerprint when
touched with fingers during handling or sticking between
the recording member and the recording member delivering
25 roller when performing recording with the recording member
mounted on the recording device, whereby making delivery
of the recording member unstable or impossible to give

1 no good actuation state of the recording device.

On the other hand, in the ink acceptor possessed by the recording member as mentioned above, it is not generally possible to obtain an adequate degree of blurring of ink and it has been difficult to control expansion (blurring) of the ink dot to a desired size when carrying out ink-jet recording.

10 In one aspect the present invention aims to provide a recording member, which satisfies sufficiently the requisite characteristics as mentioned above, being particularly excellent in ink absorbability and light-transmittance, further free from stickiness on the ink acceptor surface, and is applicable for uses observing or utilizing the transmitted light through recorded images by means of an optical instrument such as OHP, contact printer, etc., and also suitable for ink-jet recording.

20 In another aspect the present invention aims to provide a recording method by use of an ink, which is capable of performing smooth recording operation even when employing the ink-jet recording method without contamination of the ink acceptor surface by cancelling the stickiness on the surface of the ink acceptor possessed by a light-transmissive recording member and also capable of recording an image which is clear and high in resolution, and can be used in uses other than

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surface observation, namely optical instruments utilizing transmitted light through recorded images such as slide, OHP, contact printer, etc.

5 According to one aspect of the present invention, there is provided a light-transmissive recording member, which comprises a light-transmissive substrate and an ink acceptor layer provided on said substrate, said ink acceptor layer comprising a hydrophilic
10 material in the form of a continuous film, and powder particles being attached on to the surface of said ink acceptor layer.

According to another aspect of the present invention,
15 there is provided a recording method, which comprises the step of previously attaching powder particles on the surface of the ink acceptor layer of a light-transmissive recording member having a light-transmissive substrate and an ink acceptor layer
20 provided on said substrate, said ink acceptor layer comprising a hydrophilic material in the form of a continuous film, and the step of effecting recording by attaching aqueous ink on the ink acceptor layer on which said powdery particles are attached, by a
25 recording means.

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DESCRIPTION OF THE PREFERRED EMBODIMENTS

5 The recording member of the present invention has a light-transmissive substrate and an ink acceptor provided on the substrate having a surface on which recording is to be effected, namely the surface capable of absorbing

1 ink, and is particularly excellent in light-transmittance
and ink absorbability, the ink acceptor having powdery
particles imparted on its surface, whereby stickiness of
the surface can be suppressed by the powdery particles
5 attached on the surface, and yet the degree of blurring of
ink on the ink acceptor surface can be controlled within
a suitable range by controlling the amount of the powdery
particles attached on the surface.

As the substrate possessed by the recording
10 member of the present invention, there may be employed
those excellent in light transmittance such as films or
plates made of plastics such as polyester, diacetate, . .
triacetate, acrylic polymer, Cellophane (Registered Trade
Mark), celluloid, polyvinyl chloride, polycarbonate, poly-
15 imide, etc., or glass plates and others, which can suitably
be selected depending on various conditions such as the
purpose of recording, uses of the recorded image or whether
good adhesion can be obtained with the ink acceptor
provided thereon.

20 The ink acceptor possessed by the recording member
of the present invention is the portion which receives
and absorbs ink from a recording means of a recording
device or recording implement at the time of recording.

The ink acceptor possessed by the recording member
25 of the present invention can be formed by use of at
least one material, which is capable of forming a continu-
ous coat having sufficient light transmittance on the

1 above substrate, has affinity for ink, namely hydrophilic
property forms an ink acceptor with good ink absorbability
and also can form a surface on which powdery particles
as mentioned below can be attached, including, for
5 example, natural products such as starch, cationic starch,
albumin, gelatin, gum arabic, sodium alginate, etc. and
synthetic resins such as polyamide, polyacrylamide,
polyvinylpyrrolidone, quaternized polyvinyl-pyrrolidone,
polyethyleneimine, polyvinylpyridinium halide, melamine
10 resin, polyurethane, polyvinyl alcohol, etc.

Further, since a dye is generally employed as the
recording agent component of the ink for ink-jet record-
ing, it is also possible to mix the above mentioned light-
transmissive substance which can constitute the ink
15 acceptor of the recording member as mentioned above with
a material having dye fixing ability for further improve-
ment of the recording agent fixing characteristic of the
ink acceptor. As the materials having such dye fixing
ability, there may be employed at least one dye fixing
20 agent selected from cationic surfactants such as lauryl
trimethylammonium chloride, octadecylamine acetate, etc.,
dicyan diamide, copper-containing dye fixing agents and
others, if desired. Most of such materials having dye
fixing ability are cationic, and hence the aforesaid
25 light transmissive substance should preferably be a
neutral or cationic polymer, but it is also possible to
use an anionic resin, if both are not reactive with

1 each other.

For further enhancement of the recording characteristic of the recording member, fillers such as silica, clay, talc, diatomaceous earth, calcium carbonate, calcium sulfate, barium sulfate, aluminum silicate, synthetic zeolite, alumina, zinc oxide, lithopone, satin white, etc. may also be dispersed in the ink acceptor to the extent which will not impair the light transmission of the recording member. Further, for more improvement of productivity, recording characteristic and storage stability of the recording member, it is also possible to incorporate various additives such as dispersants, fluorescent dyes, pH controllers, defoaming agents, lubricants, preservatives, etc. These additives are also added to the extent which will not impair the light transmission of the recording member.

In the present invention, onto the surface of the ink acceptor are imparted a predetermined amount of powdery particles to be attached thereon.

20 The powdery particles as herein mentioned refer to microparticulate fine grain materials capable of forming powder, having a particle size preferably of 20 μm or less. This is because particles with too great sizes can give no good attaching force of the powdery particles onto the ink acceptor surface, and also involve undesirable problems such as impairment of light transmission of the recording member or failure to give adequate dot shape.

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1 In the present invention, as the material capable of constituting the powdery particles to be imparted onto the surface of the ink acceptor of the present invention, there may be included inorganic materials such as silicic
5 acid, aluminum silicate, calcium silicate, clay, talc, diatomaceous earth, calcium carbonate, calcium sulfate, barium sulfate, titanium oxide, zeolite, alumina, zinc oxide, lithopone, mica, satin white, magnesium carbonate, etc., and also organic materials such as plastic pigments,
10 benzoguanamine resin, acrylic resin, etc. As the powdery particles to be imparted onto the surface of the ink acceptor in the present invention, at least one of the powdery particles selected from those as mentioned above may suitably be combined depending on the adhering
15 fitness to the material constituting the above ink acceptor, namely so that the powder may not be released from the ink acceptor surface during recording or other handlings.

The recording member of the present invention can
20 be formed by use of various kinds of materials, by first providing an ink acceptor on a substrate and then attaching the powdery particles onto the surface of said ink acceptor.

For provision of an ink acceptor on a substrate,
25 a coating solution prepared by dissolving or dispersing a material capable of forming the ink acceptor in a suitable solvent may be applied according to such a method as

1 roll coating, blade coating, spray coating, air knife
coating, rod bar coating, etc., followed by drying.
Alternatively, a mixture in which the materials capable
of forming the aforesaid ink acceptor are homogeneously
5 mixed may be laminated on the above mentioned light-
transmissive substrate according to hot melt coating,
laminate coating, etc. to form an ink acceptor thereon.

The layer thickness of the ink acceptor possessed by
the recording member of the present invention is desired
10 to be generally about 1 to 200 μm , preferably about 5 to
80 μm . If the thickness of the ink acceptor is too
thick, light transmission (straight line transmittance)
will be lowered, while a too thin thickness will undesi-
rably result in lowering in ink absorbability.

15 Next, in the present invention, as the method for
imparting and attaching powdery particles onto the surface
of the ink acceptor possessed by the recording member,
there may be employed the method in which the necessary
amount of the powdery particles are sprayed directly onto
20 the desired surface of the ink acceptor, the method in
which they are absorbed by electrostatic adsorption or
the method in which powdery particles are suspended or
dispersed in necessary amount in an appropriate liquid,
and then applied on the ink acceptor surface by way of
25 dipping, brush coating, spraying, coating roller coating,
etc., followed by drying.

The amount of the powdery particles to be attached

1 on the ink acceptor surface and their distribution on
said surface should be selected suitably within the range
which will not impair the light transmission of the
recording member, depending on the various conditions
5 such as the extent of stickiness of the material forming
the ink acceptor, the desired ink absorbability of the
ink acceptor under the state where the powder is attached
on the surface of the ink acceptor or the extent of
blurring of the ink, etc. Accordingly, the amount of
10 the above powdery particles to be attached on the ink
acceptor surface, which will vary with individual cases
depending on the physical properties of the ink acceptor,
the powdery particles imparted onto the ink acceptor and
the ink used for recording, may preferably be selected
15 from within the range of from 10 to 1000 mg/m², more
preferably from 20 to 500 mg/m². Thus, if the amount
of the powdery particles attached on the ink acceptor
surface is generally over 1000 mg/m², the ink attached
on the ink acceptor surface may become blurred too much,
20 whereby all of the powdery particles cannot be adhered
sufficiently onto the ink acceptor surface and a part
thereof becomes readily released from the ink acceptor
surface. As the result, various inconveniences may be
caused, such as contamination of the recording device
25 with powdery particles, excessive slidability on the
ink acceptor surface which may cause slippage of the
delivery roller of the recording member to result in

1 failure of good operation of delivering the recording member, and further impairment of light transmission of the recording member. On the other hand, with an amount less than 10 mg/m^2 , there are involved
5 disadvantageously problems such that no desired tack-free effect of the ink acceptor can be obtained, and also that it becomes difficult to control blurring of the ink attached on the ink acceptor.

As described above, the surface of the ink acceptor
10 of the recording member of the present invention is imparted with a predetermined amount of powdery particles, and the powdery particles attached on the ink acceptor cancel stickiness of the ink acceptor surface simultaneously with imparting good ink absorbability to the ink
15 acceptor surface when the powder is porous, and the extent of expansion (blurring) of the ink dots in the ink acceptor can be controlled optimally by controlling the amount and distribution of the powdery particles.

On the other hand, the recording member of the
20 present invention must be sufficient in light transmitting characteristic of the recording member, in order to be used for uses utilizing transmitted light through the images recorded on said recording member, for example, optical instruments such as slide, OHP, contact printer,
25 etc.

For example, when the projected image of the recorded image is observed by means of OHP as a typical

For example of the optical instrument, it is required that the contrast between the recorded portion and the non-recorded portion should be high, and also that, in order to obtain an image which is clear and can easily be viewed, the non-recorded portion in the projected image should be light, namely the straight line light transmittance through the recording member should be at a level of a certain value or higher. In order to obtain the image suited for the above object from the test according to the test chart in OHP, namely in order that the lines with pitch width of 0.5 mm and thickness of 0.25 mm can clearly be discriminated from each other, the straight line light transmittance through the recording member is required to be 2 % or more, preferably to obtain a more clear projected image, 10 % or more. Accordingly, the light-transmitting recording member as mentioned in the present invention refers to a recording member having the total straight line transmittance of the light-transmissive substrate and the ink acceptor of 2 % or more, preferably 10 % or more.

The straight line light transmittance (T %) as mentioned in the present invention refers to the spectral transmittance of the straight line light, which entered a sample perpendicularly, transmitted through the sample, passed through the slit on the light-receiving side at a distance of at least 8 cm apart from the sample on

1 the line elongated from the incident optical path and
was received at the detector, as measured by means of,
for example, Model 323 Hitachi Self-Recording spectro-
photometer (mfd. by Hitachi Co., Ltd.) and further
5 determined from the measured spectral transmittance
according to the following formula with the use of Y
values of the tristimulus values of color:

$$T=Y/Y_0$$

T: straight line transmittance;

10 Y: Y value of sample;

Y_0 : Y value of blank.

Thus, the straight line light transmittance is
relative to the straight line light, and the method for
evaluation of the light transmitting characteristic of the
15 recording member by use of straight line light transmit-
tance is different from the methods for evaluation of
light transmitting characteristic by use of diffused
light such as diffuse transmittance (transmittance in-
clusive also of diffused light is determined by providing
20 an integrating sphere at the rear portion of the sample)
or opacity (white and black backings are lined on the
back of the sample, and the opacity is determined from
the ratio of both cases). The problems in the instruments
utilizing optical technique are caused primarily through
25 behaviors of straight line light, and therefore it is
particularly important to determine the straight line
light transmittance of a recording member for evaluation
of the light transmitting characteristic of the recording

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1 member to be used for these instruments.

The recording member of the present invention is not necessarily required to exhibit colorless transparency but it may also be a recording member exhibiting colored
5 transparency.

The recording members according to the present invention as described above have satisfactory light transmitting characteristic, being particularly excellent in ink fixing characteristic which has been inferior in
10 the recording members of the prior art such as light transmitting film, to enable high speed printing and multi-color printing by ink-jet recording, and therefore they are very suitable as record-bearing members for using the recorded images for uses other than surface
15 observation, namely optical instruments utilizing the transmitted light through recorded images, such as slide, OHP, contact printer, etc.

Further, because of the powdery particles attached on the surface of the ink acceptor of the recording member
20 of the present invention, stickiness of the surface of the ink acceptor is cancelled, simultaneously with good ink absorbability of the ink acceptor surface in the case when the powdery particles are porous, and the extent of expansion of ink dots on the ink acceptor can be controlled
25 optimally by controlling the amount and the distribution of the powdery particles.

The recording method of the present invention

1 includes the two principal steps, namely the step of previously
2 imparting the powdery particles to the surface
3 of the ink acceptor where recording is to be effected
4 during recording (the surface which receives ink) and the
5 step of attaching ink onto the ink acceptor surface, on
6 which the powdery particles are attached, by a recording
7 means.

8 The recording member to be used in the method of
9 the present invention can be formed by use of the mate-
10 rials as described in detail above.

11 In the method of the present invention, as the
12 next step, recording is effected by attaching ink by
13 various kinds of recording means on the ink acceptor
14 surface having such a surface state.

15 As the recording means to be employed in the
16 method of the present invention, there may be included
17 those which perform recording by use of an aqueous ink,
18 for example, writing implements such as fountain pen,
19 aqueous ball pen, felt pen, etc., and further ink-jet
20 recording devices.

21 In carrying out recording by such recording means
22 as mentioned above, the ink acceptor surface is under
23 non-sticky state as described above, and therefore better
24 ink-absorbability can be obtained even when performing
25 recording by use of, for example, fountain pen, aqueous
26 ball pen or felt pen, whereby fingerprint will hardly
27 be attached on the ink acceptor surface even when touched

1 with a finger to result in no contamination of the surface.

Also, even when performing recording by means of an ink-jet recording device, adhesion between the recording member and the rollers for delivery of the recording
5 member can be prevented, whereby smooth recording operation may be possible without unstable or impossible delivery of recording member.

Further by appropriately controlling the amount of the above-mentioned particulate material attached
10 on the ink acceptor surface, the extent of expansion of the ink dots on the ink acceptor can be controlled optimally, whereby it has been rendered possible to record a clear and highly resolved image.

As described above, according to the recording
15 method of the present invention, smooth recording operations can be performed, while cancelling the stickiness of the ink acceptor possessed by the light-transmissive recording member, without contamination of the ink acceptor surface. Moreover, good ink absorbability can be given
20 to the ink acceptor and also, when employing an ink-jet recording device, good expansion of ink dots can be obtained. Consequently, the image recorded according to the method of the present invention became a clear and highly resolved image which can be used in uses other
25 than surface observation, namely in optical instruments utilizing transmitted light through recorded images such as slide, OHP, contact printer, etc.

1 The present invention is described in more detail
by referring to the following Examples and Comparative
Examples.

5 Example 1

 Using a polyethyleneterephthalate film with a
thickness of 100 μm (produced by ICI Co.) as the light-
transmissive substrate, a coating solution having the
composition as shown below was applied on the substrate by
10 the blade coater method to a dried film thickness of the ink
acceptor of 20 μm , followed by drying under the conditions
of 80 °C and 20 minutes, to form an ink acceptor.

 Coating solution composition:

15	Polyvinyl pyrrolidone K-30	
	(trade name: K-30, produced by GAF Co.)	
		50 wt. parts
	Benzylidene sorbitol	
	(trade name: Gelol D, produced by Shinnippon	
20	Rika Co.)	5 wt. parts
	Dimethylformamide	45 wt. parts

 Next, the ink acceptor surface was tapped with a
cotton bag containing talc powder with an average particle
25 size of 6 μm (trade name: Talc SWS, produced by Tsuchiya
Kaolin Co.) to have talc attached on the surface of the
ink acceptor, thus providing a recording member of the

present invention which can be used for uses utilizing transmitted light through recorded image. The amount of the powder particles attached on the ink acceptor surface of the recording member obtained was found to be 200 mg/m^2 .

On the recording member obtained, ink-jet recording was effected by means of the recording device having an on-demand type ink-jet recording head which discharged ink through a piezo-vibrator (ink discharging orifice diameter: $65 \text{ }\mu\text{m}$, piezo-vibrator driving voltage: 75 V , frequency: 2.5 KHz) with the use of inks of four colors as shown below, to obtain a recorded image.

[Ink composition]

Yellow ink

15	C.I. Acid Yellow 23	2 wt. parts
	Diethylene glycol	15 wt. parts
	Water	85 wt. parts

Red ink

	C.I. Acid Red 37	2 wt. parts
20	Diethylene glycol	15 wt. parts
	Water	85 wt. parts

Blue ink

	C.I. Direct Blue 86	2 wt. parts
	Diethylene glycol	15 wt. parts
25	Water	85 wt. parts

1 Black ink

C.I. Direct Black 19	2 wt. parts
Diethylene glycol	15 wt. parts
Water	85 wt. parts

5

For the recorded image thus obtained, the five items as shown below were tested for evaluation of the recording characteristics and the optical instrument aptitude of the recording member.

10 1) Ink fixing time was evaluated by measuring the period in which the ink was dried without being attached on the finger, when the recording member after recording was left to stand under the conditions of 20 °C and 65 % RH or 20 °C and 90 % RH and the recorded image was touched with a
15 finger.

2) Straight line light transmittance was measured for evaluation of light transmitting characteristic as one evaluation of optical instrument aptitude, and calculated from the spectral transmittance as defined above measured
20 for the recording member before practicing recording by means of Model 323 Hitachi Self-Recording Spectrophotometer.

3) The ink dot density was measured for black dots recorded under the conditions of 20 °C and 65 % RH by means of Sakura Micro Densitometer PDM-5)produced by Konishiroku
25 Shashin Kogyo K.K.) by applying JIS K 7605 for printed letter microdots.

4) OHP aptitude was measured as a typical example of

1 optical instrument aptitude of the recording member and
 judged by observation with eyes of the recorded image
 which was projected on a screen by OHP, with the non-
 recorded portion being light and the recorded image giving
 5 a clear projected image of high OD (optical density) and
 high contrast which can be easily viewed being rated as O,
 with the non-recorded portion slightly dark and the recorded
 image with slightly lower OD, showing lines with pitch width
 of 0.5 mm and thickness of 0.25 mm which could not clearly
 10 be discriminated from each other being rated as Δ; with the
 non-recorded portion which is considerably dark and the
 recorded image showing lines with pitch width of 1 mm and
 thickness of 0.5 mm which could not clearly be discriminated
 from each other or the recorded image which could not be
 15 discriminated from the non-recorded portion being rated as
 x.

5) Blocking characteristic was tested by applying a
 load of 500 g on 50 sheets of recording members piled,
 which was then left to stand a whole day and night under the
 20 conditions of 30 °C and 90 % RH, and observing generation of
 blocking. The case when no blocking was generated was rated
 as O, while the case when blocking was generated as x.

Further, on the basis of these results, the record-
 ing members obtained in this Example were comprehensively
 25 evaluated. In this evaluation, those which enable good
 recording operation by means of a recording device while
 satisfying various characteristics as the recording member
 wholly without exhibiting stickiness on the ink acceptor

1 surface are rated as (O). those which, while satisfying
various characteristics as the recording member wholly,
exhibit stickiness on the ink-receiving layer surface, and
cannot effect recording due to adhesion with rollers for
5 delivering recording member, etc. when performing recording
under the conditions of 20 °C and 90 % RH as (Δ), and those
which cannot perform recording operation smoothly due to
stickiness on the ink acceptor surface even when recording
is carried out under the conditions of 20 °C and 65 % RH as
10 (x).

The results obtained are shown in Table 1.

Example 2

Using a triacetate film with a thickness of 100 μm
(produced by Fuji Photofilm) as the light-transmissive
15 substrate, a coating solution having the composition as
shown below was applied on the substrate by the blade
coater method to a dried film thickness of the ink acceptor
of 10 μm, followed by drying under the conditions of 100 °C
and 20 minutes to form an ink acceptor.

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Coating solution composition:

Polyvinyl alcohol

(trade name: PVA-210, produced by Kuraray)

10 wt. parts

25

Polyethyleneimine

(trade name: P-1000, produced by Nippon

Shokubai Kagaku) 0.5 wt. parts

Water

45 wt. parts

1 Next, on the ink acceptor surface was applied by
spray coating a suspension containing 5 wt. % of anhydrous
silicon dioxide powder with an average particle size of
30 μm (trade name: Aerosil MOX80, produced Nippon Aerosil
5 Co.) suspended in methanol, followed by drying, to obtain
a recording member which can be used for uses utilizing
transmitted light through recorded image. ("Aerosil" is a
registered trade mark).

The amount of the powder particles attached on the
ink acceptor surface of the recording member was found to be
10 80 mg/m^2 .

On the recording member obtained, ink-jet recording
by use of four colors was performed similarly as in Example
1 to obtain a recorded image.

For the recorded image thus obtained, recording
15 characteristics and optical instrument aptitude were
evaluated similarly as in Example 1 to obtain the results as
shown in Table 1.

Example 3

Using a polyester film with a thickness of 100 μm
20 (produced by ICI Co.) as the light-transmissive substrate,
a coating solution having the composition as shown below
was applied by a wire bar to a dried film thickness of the
ink acceptor of 30 μm , followed by drying to form an ink
acceptor.

25 [Coating solution composition]

Polyvinyl pyrrolidone

(trade name: K-30, produced by GAF Co.)

10 wt. parts

1 Polyvinyl alcohol
(trade name: PVA-220, produced by Kuraray)
10 wt. parts
Water 80 wt. parts

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Next, on the ink acceptor surface of the recording member thus prepared, diatomaceous earth with an average particle size of 3 μm (trade name: Super Floss, produced by Tsuchiya Kaolin Co.) was attached by electrostatic
10 adsorption to obtain a recording member of the present invention.

The amount of the powdery particles attached on the ink acceptor surface of the recording member obtained was found to be 300 mg/m^2 .

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On the recording member obtained was effected the ink-jet recording by use of inks of four colors similarly as in Example 1 to obtain a recorded image.

For the recorded image thus obtained, recording characteristics and optical instrument aptitude were
20 evaluated similarly as in Example 1 to obtain the results as shown in Table 1.

Example 4

Example 3 was repeated except that the coating solution as shown below was used and aluminium hydroxide
25 fine powder (trade name: Hygillite H-40, average particle size: 1.5 μm , produced by Showa Keikinzoku) was attached as the powdery particles in an amount of 600 mg/m^2 on the ink acceptor surface, to prepare

1 a recording member of the present invention.

[Coating solution composition]

Carboxymethyl cellulose 2 wt. parts
5 (trade name: Cellogen BS, produced by
Daiichi Kogyo Co.)
Water 10 wt. parts

On the recording member obtained was effected the
10 ink-jet recording by use of inks of four colors similarly
as in Example 1 to obtain a recorded image.

For the recorded image thus obtained, recording
characteristics and optical instrument aptitude were
evaluated similarly as in Example 1 to obtain the results
15 as shown in Table 1.

Example 5

Example 3 was repeated except that the coating
solution as shown below was used and Nipsil E200 (trade
name for a synthetic silica, average particle size: 2.5 μ m,
20 produced by Nippon Silica Kogyo Co.) was attached as the
powdery particles in an amount of 400 mg/m² on the ink
acceptor surface, to prepare a recording member of the
present invention.

[Coating solution composition]

25 Styrene-maleate Na salt 10 wt. parts
(trade name: Discoat KS-140, produced by
Daiichi Kogyo Co.)
Water 90 wt. parts

1 On the recording member obtained was effected the
ink-jet recording by use of inks of four colors similarly
as in Example 1 to obtain a recorded image.

5 For the recorded image thus obtained, recording
characteristics and optical instrument aptitude were
evaluated similarly as in Example 1 to obtain the results
as shown in Table 1.

Example 6

10 Example 3 was repeated except that the coating
solution as shown below was used and zeolite powder (trade
name: Zeo-49, average particle size: 5 μ m, produced by
J.M. Huber Corp.) was attached as the powdery particles in
an amount of 200 mg/m² on the ink acceptor surface, to
prepare a recording member of the present invention.

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[Coating solution composition]

Hydrophilic urethane	80 wt. parts
(trade name: Toricoat G, produced	
by Taiho Industries Co. Ltd.)	
Methyl ethyl ketone	20 wt. parts

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25 On the recording member obtained was effected the
ink-jet recording by use of inks of four colors similarly
as in Example 1 to obtain a recorded image.

For the recorded image thus obtained, recording
characteristics and optical instrument aptitude were
evaluated similarly as in Example 1 to obtain the results

1 as shown in Table 1.

Example 7.

Example 3 was repeated except that the coating solution as shown below was used and Syloid #161 (trade name for a synthetic silica, average particle size: 7 μ m, produced by Fuji-Davison Chemical Ltd) was attached as the powdery particles in an amount of 100 mg/m² on the ink acceptor surface, to prepare a recording member of the present invention. ("Syloid" is a registered Trade Mark).

10 [Coating solution composition]

Water-soluble acrylic resin 20 wt. parts

(trade name: Cogum HW-7, produced
by Showa Kobunshi Co.)

Water 80 wt. parts

15

On the recording member obtained was effected the ink-jet recording by use of inks of four colors similarly as in Example 1 to obtain a recorded image.

For the recorded image thus obtained, recording characteristics and optical instrument aptitude were evaluated similarly as in Example 1 to obtain the results as shown in Table 1.

Example 8

Example 3 was repeated except that the coating solution as shown below was used and Aerosil R972 (trade name, average particle size: 15 μ m, produced by Nippon Aerosil Co.) was attached as the powdery particles in an

1 amount of 50 mg/m² on the ink acceptor surface, to prepare
a recording member of the present invention.

[Coating solution composition]

5	Water-soluble acrylic resin	10 wt. parts
	(trade name: Cogum HW-7, produced	
	by Showa Kobunshi Co.)	
	Acrylic resin emulsion	10 wt. parts
	(trade name: S-100A, produced	
10	by Showa Kobunshi Co.)	
	Water	70 wt. parts

On the recording member obtained was effected the
ink-jet recording by use of inks of four colors similarly
15 as in Example 1 to obtain a recorded image.

For the recorded image thus obtained, recording
characteristics and optical instrument aptitude were
evaluated similarly as in Example 1 to obtain the results
as shown in Table 1.

20 Comparative Examples 1 - 3

In Examples 1 - 3, the films before attachment of
powdery particles were employed as the recording member,
and ink-jet recording was performed similarly as in Example
1. The resultant recorded images were evaluated for record-
25 ing characteristics and optical instrument aptitude of the
recording members similarly as in Example 1. The results
obtained are shown in Table 2.

Example 9

Using an ink-jet recording device (ink discharging orifice diameter: 65 μm , piezo-vibrator driving voltage: 75 V, frequency: 2.5 KHz) as the recording means, recording was effected on the light-transmissive recording member with the use of inks of four colors according to the method of the present invention.

The recording member used in this Example was prepared by applying a coating solution having the composition as shown below on a polyethyleneterephthalate film with a thickness of 100 μm (produced by ICI Co.) as the light-transmissive substrate by the blade coater method to a dried film thickness of the ink acceptor of 20 μm , followed by drying under the conditions of 80 $^{\circ}\text{C}$ and 20 minutes, to form an ink acceptor.

[Coating solution composition]

Polyvinyl pyrrolidone K-30

(trade name: K-30, produced by GAF Co.)

20

50 wt. parts

Benzylidene sorbitol

(trade name: Gelol D, produced by Shinnippon Rika Co.)

5 wt. parts

Dimethylformamide

45 wt. parts

25

Next, the ink acceptor surface of the recording member thus prepared was tapped with a cotton bag containing

1 talc powder with an average particle size of 6 μ m (trade
 name: Talc SWS, produced by Tsuchiya Kaolin Co.) to have
 talc attached on the surface of the ink acceptor. The
 amount of the powder particles attached on the ink acceptor
 5 surface of the recording member obtained was found to be
 200 mg/m².

On the surface of the ink acceptor on which talc
 powder had been attached, recording was effected by means
 of the ink-jet recording device described above with the
 10 use of inks of four colors as shown below, to obtain a
 recorded image.

[Ink composition]

Yellow ink

15	C.I. Acid Yellow 23	2 wt. parts
	Diethylene glycol	15 wt. parts
	Water	85 wt. parts

Red ink

20	C.I. Acid Red 37	2 wt. parts
	Diethylene glycol	15 wt. parts
	Water	85 wt. parts

Blue ink

	C.I. Direct Blue 86	2 wt. parts
25	Diethylene glycol	15 wt. parts
	Water	85 wt. parts

1 Black ink

C.I. Direct Black 19	2 wt. parts
Diethylene glycol	15 wt. parts
Water	85 wt. parts

5

In Table 1, there are shown the recording characteristics of the recording member of this Example and the results of the evaluation of the image characteristics for the image recorded thereon. The evaluation for each of the
10 items shown in Table 3 was conducted according to the following methods.

1) Ink fixing time was evaluated by measuring the period in which the ink was dried without being attached on the finger, when the recording member after recording was
15 left to stand under the conditions of 20 °C and 65 % RH or 20 °C and 90 % RH and the recorded image was touched with a finger.

2) Straight line light transmittance was measured for evaluation of light transmitting characteristic as one
20 evaluation of optical instrument aptitude, and calculated from the spectral transmittance as defined above measured for the recording member before practicing recording by means of Model 323 Hitachi Self-Recording Spectrophotometer.

3) The ink dot density was measured for black dots
25 recorded under the conditions of 20 °C and 65 % RH by means of Sakura Micro Densitometer PDM-5 (produced by Konishiroku Shashin Kogyo K.K.) by applying JIS K 7650 for printed

1 letter microdots.

4) OHP aptitude was measured as a typical example of optical instrument aptitude of the recorded image and judged by observation with eyes of the recorded image which was
5 projected on a screen by OHP, with the non-recorded portion being light and the recorded image giving a clear projected image of high OD (optical density) and high contrast which can be easily viewed being rated as O; with the non-recorded portion slightly dark and the recorded image with slightly
10 lower OD, showing lines with pitch width of 0.5 mm and thickness of 0.25 mm which could not clearly be discriminated from each other being rated as Δ; with the non-recorded portion which is considerably dark and the recorded image showing lines with pitch width of 1 mm and thickness of 0.5
15 mm which could not clearly be discriminated from each other or the recorded image which could not be discriminated from the non-recorded portion being rated as x.

5) Blocking characteristic was tested by applying a load of 500 g on 50 sheets of piled recording members not
20 subjected to recording, which was then left to stand a whole day and night under the conditions of 30 °C and 90 % RH, and observing generation of blocking. The case when no blocking was generated was rated as O, while the case when blocking was generated as x.

1 Further, on the basis of these results, overall
evaluation was carried out. In the overall evaluation,
those which afford a recorded image which is excellent in
ink-jet recording characteristics and has sufficient light
5 transmittance and optical device aptitude and which enable
good recording operation by means of a recording device
while satisfying various characteristics as the recording
member wholly without exhibiting stickiness on the ink
acceptor surface of the recording member are rated as O,
10 those which, while having satisfactory recording charac-
teristics takes relatively much time to fix ink, and cannot
effect satisfactory recording due to adhesion with rollers
for delivering recording member, etc. when performing
recording under the conditions of 20 °C and 90 % RH as Δ,
15 and those which cannot perform recording operation smoothly
due to stickiness on the ink acceptor surface even when
recording is carried out under the conditions of 20 °C and
65 % RH as x.

The results obtained are shown in Table 3.

20 Example 10

A recording member was prepared by applying a coating
solution having the composition as shown below on a
triacetate film with a thickness of 100 μm (produced by Fuji
Photofilm) as the light-transmissive substrate by the blade
25 coater method to a dried film thickness of the ink acceptor
of 10 μm, followed by drying under the conditions of 100 °C
and 20 minutes to form an ink acceptor.

1 [Coating solution composition]

Polyvinyl alcohol

(trade name: PVA-210, produced by Kuraray)

10 wt. parts

5 Polyethyleneimine

(trade name: P-1000, produced by Nippon

Shokubai Kagaku) 0.5 wt. parts

Water

45 wt. parts

10 Next, on the ink acceptor surface of the recording member thus prepared was applied by spray coating a suspension containing 5 wt. % of anhydrous silicon dioxide powder with an average particle size of 30 μm (trade name: Aerosil MOX80, produced Nippon Aerosil Co.) suspended in
15 methanol, followed by drying.

The amount of the powder particles attached on the ink acceptor surface of the recording member was found to be 80 mg/m^2 .

On the ink acceptor of the recording member on
20 which silicon dioxide powdery particles had been attached, ink-jet recording by use of four colors was performed similarly as in Example 9 to obtain a recorded image.

For the recording member thus obtained, recording characteristics and image characteristics of the recorded
25 image were evaluated similarly as in Example 9 to obtain the results as shown in Table 3.

Example 11

1 A recording member was prepared by applying a
coating solution having the composition as shown below on
a polyester film with a thickness of 100 μm (produced by
ICI Co.) as the light-transmissive substrate by a wire bar
5 to a dried film thickness of the ink acceptor of 30 μm ,
followed by drying to form an ink acceptor.

[Coating solution composition]

Polyvinyl pyrrolidone

(trade name: K-30, produced by GAF Co.)

10 wt. parts

Polyvinyl alcohol

(trade name: PVA-220, produced by Kuraray)

10 wt. parts

15 Water

80 wt. parts

Next, on the ink acceptor surface of the recording
member thus prepared, diatomaceous earth with an average
particle size of 3 μm (trade name: Super Floss, produced
20 by Tsuchiya Kaolin Co.) was attached by electrostatic
adsorption.

The amount of the powdery particles attached on the
ink acceptor surface of the recording member obtained was
found to be 300 mg/m^2 .

25 On the ink acceptor of the recording member on
which diatomaceous earth had been attached on was effected
the ink-jet recording by use of inks of four colors

1 similarly as in Example 9 to obtain a recorded image.

For the recording member thus obtained, recording characteristics and image characteristics of the recorded image were evaluated similarly as in Example 9 to obtain
5 the results as shown in Table 3.

Example 12

Ink-jet recording was carried out similarly as in Example 11 except that the coating solution as shown below was used to form the ink acceptor and Hygillite H-40 (trade
10 name, average particle size: 1.5 μm , produced by Tsuchiya Kaolin Co.) was attached as the powdery particles in an amount of 600 mg/m^2 on the ink acceptor surface of the recording member prepared, to obtain a recorded image.

15 [Coating solution composition]

Carboxymethyl cellulose 2 wt. parts

(trade name: Cellogen BS, produced by
Daiichi Kogyo Co.)

Water 10 wt. parts

20

Recording characteristics of the recording member thus obtained and image characteristics of the recorded image were evaluated similarly as in Example 9 to obtain the results as shown in Table 3.

25 Example 13

Ink-jet recording was carried out similarly as in Example 11 except that the coating solution as shown below

1 was used to form the ink acceptor and Nipsil E200 (trade
name, average particle size: 2.5 μm , produced by Nippon
Silica Kogyo Co.) was attached as the powdery particles in
an amount of 400 mg/m^2 on the ink acceptor surface of the
5 recording member prepared, to obtain a recorded image.

[Coating solution composition]

Styrene-maleate Na salt 10 wt. parts
(trade name: Discoat KS-140, produced
10 by Daiichi Kogyo Co.)

Water 90 wt. parts

Recording characteristics of the recording member
thus obtained and image characteristics of the recorded
15 image were evaluated similarly as in Example 9 to obtain
the results as shown in Table 3.

Example 14

Ink-jet recording was carried out similarly as in
Example 11 except that the coating solution as shown below
20 was used to form the ink acceptor and Zeolite powder (trade
name: Zeo-49, average particle size: 5 μm , produced by
J.M. Huber Corp.) was attached as the powdery particles in
an amount of 200 mg/m^2 on the ink acceptor surface of the
recording member prepared, to obtain a recorded image.

1 [Coating solution composition]

Hydrophilic urethane 80 wt. parts

(trade name: Toricoat G, produced
by Taiho Industry Co., Ltd.)

5 Methyl ethyl ketone 20 wt. parts

Recording characteristics of the recording member thus obtained and image characteristics of the recorded image were evaluated similarly as in Example 9 to obtain the results as shown in Table 3.

Example 15

Ink-jet recording was carried out similarly as in Example 11 except that the coating solution as shown below was used to form the ink acceptor and Syloid #161 (trade name, average particle size: 7 μm , produced by Fuji-Davison Chemical Ltd.) was attached as the powdery particles in an amount of 100 mg/m^2 on the ink acceptor surface of the recording member prepared, to obtain a recorded image.

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[Coating solution composition]

Water-soluble acrylic resin 20 wt. parts

(trade name: Cogum HW-7, produced
by Showa Kobunshi Co.)

25 Water 80 wt. parts

Recording characteristics of the recording member thus obtained and image characteristics of the recorded

1 image were evaluated similarly as in Example 9 to obtain
the results as shown in Table 3.

Example 16

5 Ink-jet recording was carried out similarly as in
Example 11 except that the coating solution as shown below
was used to form the ink acceptor and Aerosil R972 (trade
name, average particle size: 15 μm , produced by Nippon
Aerosil Co.) was attached as the powdery particles in an
amount of 50 mg/m^2 on the ink acceptor surface of the
10 recording member prepared, to obtain a recorded image.

[Coating solution composition]

Water-soluble acrylic resin	10 wt. parts
(trade name: Cogum HW-7, produced	
15 by Showa Kobunshi Co.)	
Acrylic resin emulsion	20 wt. parts
(trade name: S-100A, produced by Showa	
Kobunshi Co.)	
Water	70 wt. parts

20

Recording characteristics of the recording member
thus obtained and image characteristics of the recorded
image were evaluated similarly as in Example 9 to obtain
the results as shown in Table 3.

25 Comparative Examples 4 - 6

In Examples 9 - 11, ink-jet recording was performed
similarly as in Example 9 except that the step of attachment

1 of powdery particles was omitted.

Recording characteristics of the recording member thus obtained and image characteristics of the recorded image were evaluated similarly as in Example 9. The
5 results obtained are shown in Table 4.

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Table 1

	Straight line transmittance (%)	Ink fixing time		Dot density	OHP aptitude	Blocking characteristic 30°C65%RH	Overall evaluation
		20°C65%RH	20°C90%RH				
Example 1	58	15 sec.	20 sec.	0.5	○	○	○
Example 2	78	2 min.	3 min.	0.8	○	○	○
Example 3	68	3 min.	2 min. and 40 sec.	0.9	○	○	○
Example 4	63	1 min.	2 min.	0.8	○	○	○
Example 5	65	1 min.	2 min. and 20 sec.	0.9	○	○	○
Example 6	68	1 min.	2 min.	0.8	○	○	○
Example 7	70	25 sec.	40 sec.	0.7	○	○	○
Example 8	73	15 sec.	30 sec.	0.7	○	○	○

Table 2

	Straight line transmittance (%)	Ink fixing time		Dot density	OHP aptitude	Blocking characteristic 30°C65%RH	Overall evaluation
		20°C65%RH	20°C90%RH				
Comparative example 1	64	17 sec.	Sticky, recording impossible	0.6	○	×	△
Comparative example 2	83	3 min.	Sticky, recording impossible	0.8	○	×	△
Comparative example 3	78	3 min.	Sticky, recording impossible	—	—	×	×

Table 3

	Straight line transmittance (%)	Ink fixing time		Dot density	OHP aptitude	Blocking characteristic 30°C65%RH	Overall evaluation
		20°C65%RH	20°C90%RH				
Example 9	58	15 sec.	20 sec.	0.5	○	○	○
Example 10	78	2 min.	3 min.	0.8	○	○	○
Example 11	68	3 min.	2 min. and 40 sec.	0.9	○	○	○
Example 12	63	1 min.	2 min.	0.8	○	○	○
Example 13	65	1 min.	2 min. and 20 sec.	0.9	○	○	○
Example 14	68	1 min.	2 min.	0.8	○	○	○
Example 15	70	25 sec.	40 sec.	0.7	○	○	○
Example 16	73	15 sec.	30 sec.	0.7	○	○	○

Table 4

	Straight line transmittance (%)	Ink fixing time		Dot density	OHP aptitude	Blocking characteristic 30°C65%RH	Overall evaluation
		20°C65%RH	20°C90%RH				
Comparative example 4	64	17 sec.	Sticky, recording impossible	0.6	○	×	△
Comparative example 5	83	3 min.	Sticky recording impossible	0.8	○	×	△
Comparative example 6	78	3 min.	Sticky recording impossible	—	—	×	×

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CLAIMS

1. A light-transmissive recording member, which comprises a light-transmissive substrate and an ink acceptor layer provided on said substrate, said ink acceptor layer comprising a hydrophilic material in the form of a continuous film, and powder particles being attached on to the surface of said ink acceptor layer.
2. A light-transmissive recording member according to claim 1, wherein the powdery particles have a particle size of 20 um or less.
3. A light-transmissive recording member according to claim 1 or claim 2, wherein the material constituting the powdery particles is selected from the group consisting of silicic acid, aluminum silicate, calcium silicate, clay, talc, diatomaceous earth, calcium carbonate, calcium sulfate, barium sulfate, titanium oxide, zeolite, alumina, zinc oxide, lithopone, mica, satin white, magnesium carbonate, plastic pigments, benzoguanamine resin and acrylic resin.
4. A light-transmissive recording member according



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to any preceding claim, wherein the layer thickness of the ink acceptor is 1 to 200 μm .

5. A light-transmissive recording member according to
5 any preceding claim, wherein the amount of the powdery particles attached on the ink acceptor surface is 10 to 1000 mg/m^2 .

6. A recording method, which comprises the step of
10 previously attaching powder particles on the surface of the ink acceptor layer of a light-transmissive recording member having a light-transmissive substrate and an ink acceptor layer provided on said substrate, said ink acceptor layer comprising a hydrophilic
15 material in the form of a continuous film, and the step of effecting recording by attaching aqueous ink on the ink acceptor layer on which said powdery particles are attached, by a recording means.

20 7. A recording method according to claim 6, wherein the attachment of the powdery particles on the ink acceptor surface is carried out by direct spraying, electrostatic adsorption or the method in which suspension or dispersion of the powdery particles is
25 applied on the ink acceptors followed by drying.



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8. A recording method according to claim 6 or claim 7, wherein the powdery particles have a particle size of 20 μm or less.

5 9. A recording method according to any of claims 6 to 8, wherein the material constituting the powdery particles is selected from the group consisting of silicic acid, aluminum silicate, calcium silicate, clay, talc, diatomaceous earth, calcium carbonate, 10 calcium sulfate, barium sulfate, titanium oxide, zeolite, alumina, zinc oxide, lithopone, mica, satin white, magnesium carbonate, plastic pigments, benzoguanamine resin and acrylic resin.

15 10. A recording method according to any of claims 6 to 9 wherein the amount of the powdery particles attached on the ink acceptor surface is 10 to 1000 mg/m^2 .

20 11. A recording method comprising the step of effecting recording on a light-transmissive recording member according to any of claims 1 to 5 by attaching aqueous ink to the ink acceptor layer having the powder particles thereon.

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50.

12. A light-transmissive recording member substantially as described herein with reference to any of Examples 1-16.

5 13. A recording method substantially as described herein with reference to any of Examples 1-16.
