

Recording Medium

BACKGROUND OF THE INVENTION

5 Field of the Invention

This invention relates to a recording medium to be used suitably for the ink jet recording method, particularly a recording medium which is excellent in ink receiving characteristic, sharpness of the recorded image, paper feeding and conveying characteristic in a printer, blocking resistance, and also, when said recording medium is transparent, excellent in light-transmittance as well as ink receiving characteristic.

Description of the Prior Art

15 The ink jet recording method performs recording by generating small droplets of ink according to various systems of discharging ink (recording liquid), such as electrostatic attracting system, the system to give mechanical vibration or displacement to the recording liquid by use of a piezoelectric element or the system to utilize the pressure of expansion of the recording liquid by heating and ebullition, permitting them to fly and attaching a part or all thereof onto a recording medium such as paper. This method is attract-
20 ing attention as a method which can reduce noise and realize high speed printing and multi-color printing.

The inks for ink jet recording are primarily

1 composed of water from the view point of safety and
recording characteristics, and most of them contain
polyhydric alcohols, etc. added therein for prevention
of clogging of nozzles and improvement of discharging
5 characteristic.

As the recording medium to be used for the ink
jet recording, there have been employed recording
medium comprising conventional paper or comprising a
porous ink absorbing layer provided on the base material
10 called as the paper for ink jet recording. However,
with improvement in performance of the ink jet record-
ing device, such as high speed recording or multi-color
recording and with popularization thereof, most exten-
sive characteristics are becoming demanded for the
15 recording medium. More specifically, the following
requirements are to be satisfied for ink jet recording
medium in order to obtain a recorded image of high
resolution and high quality:

20 1) Fixing of ink to the recording medium is as
rapid as possible.

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

25 3) Although the ink droplets may be somewhat
diffused on the recording medium, the size of ink dot
should be of the desired size not more than greater
than is necessary.



1 4) The shape of ink dot should be approximate to true circle, and its circumference should be smooth.

5) The OD (optical density) of ink dot should be high, without obscurity around the dot.

5 Further, in order to obtain a recorded image of high resolution which is comparable to the color photography by the multi-color ink jet recording method, in addition to the above requisite performances, the following requirements should also be satisfied:

10 6) The color forming characteristic of the coloring components of ink should be excellent.

7) Since droplets as many as the number of colors of ink may be attached on the same spot overlapped on one another, the ink fixing characteristic should particularly be excellent.

15 8) The surface should have lustre.

9) The medium should have a high degree of whiteness.

20 10) The medium should be fed and conveyed smoothly in a printer.

25 The images by ink-jet recording have been employed only for observation of surface images, but a recording medium is now demanded, which are suitable for uses other than surface image observation, as the ink jet recording device is improved in performance and widely used. The uses other than surface image observation may include those in which recorded images are

1 projected by means of optical instruments such as
slides or OHP (overhead projector) on a screen, etc.
for observation of those images, color separating
plates for preparation of positive plates for color
5 printing, CMF (color mosaic filter) for color display
of liquid crystal, etc.

While the diffused light of a recorded image
is primarily observed when the recorded image is to be
used for surface image observation, the transmitted
10 light passing through the recorded image is the matter
of importance in a recording medium to be used in uses
other than surface image observation. Accordingly, the
recording medium to be used for these uses is required
to have excellent light transmitting characteristic,
15 particularly linear transmission factor, in addition to
the performances required for recording media for ink
jet recording in general as described above.

However, no recording medium has yet been known,
which satisfies all of these requisite performances.

20 Most of the recording media for observation of
surface images employ the system in which a porous
ink-absorbing layer is provided on the surface and the
recording liquid is absorbed into the porous voids to
fix the recording agent.

25 On the other hand, when the surface of the ink
absorbing layer is non-porous, non-volatile components
such as polyhydric alcohols in the ink will remain on

the surface of recording medium for a long time after recording, and a long time is necessary before drying and fixing of the ink, whereby there have been involved the drawbacks such as contamination of cloths or damaging of the recorded images.

European Patent Application 0049040 discloses a composite medium for sorbing liquids comprising, in combination, a liquid-sorbent underlayer and, overlying said underlayer, a liquid-permeable surface layer capable of retaining its integrity in contact with said liquid and liquid applying means, the liquid sorptivity of said underlayer being greater than the liquid sorptivity of said surface layer. The composite medium is designed as a recording medium for mechanical plotters employing organic ink. The liquid permeable surface layer is primarily intended for retaining the integrity of the surface of the medium to enable the rapid pen movement and to prevent clogging of the tip of the pen caused by gouging of the surface of the medium. On the other hand, the present invention is concerned with aqueous inks having very different properties and does not require such property of retaining the integrity of the surface since recording

means does not contact with the recording medium and the rigidity of the layer overlying the ink-absorbing under layer rather causes troubles: the rigidity of the layer will suppress the swelling of the under layer to
5 reduce the ink-retention ability and to induce blurring.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a recording medium which enables ink jet recording with
10 improved ink reception, including quick drying, non-smearing characteristics and sharpness of recorded images.

Another object of the present invention is to provide a transparent recording medium for ink jet
15 recording, which can be used for observation of transmitted light such as for observation of projected images on a screen, etc. by optical instruments such as a slide or OHP, color separating plate in preparation of a positive plate in color printing, or CMF, etc. to be
20 used in color display such as liquid crystal.

Further object of the present invention is to provide a recording medium for ink jet recording which has qualities commonly required for improvement of commercial values are such that the recording medium
25 when applied on a printer may be smoothly fed and conveyed without jamming, namely good in delivering

characteristic, that the recording medium may be free from blocking by adhesion with a coating agent, etc. during storage of the recording medium, and that no fingerprint may be formed by finger touch.

5

According to one aspect of the invention there is provided an ink-jet printing process in which aqueous ink droplets are propelled onto a recording medium comprising a substrate having thereon a water-sorptive under layer covered by an upper layer of substantially water-resistant polymeric material which is sufficiently thin to provide immediate water and air permeability. There may be a fine powdery layer on the upper surface of the recording medium.

10

When recording is effected on the above recording medium with a large amount of ink, although the ink can be received, the printed portion becomes turbid, which turbid portion gives a dark projected image when employed for observation of transmitted light by OHP, etc., thereby ensuing sometimes a problem that the color forming characteristic may be lowered.

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Accordingly, further studies have been made to obtain a recording medium without turbidity at the printed

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portion and yet having excellent ink receiving characteristic and color forming characteristic.

According to an aspect of the present invention,
5 there is provided a recording medium for recording
with aqueous ink without direct contact with a
recording member therewith comprising a substrate
having thereon a water-sorptive under layer covered
by an upper layer of substantially water-resistant
10 polymeric material which is sufficiently thin to
provide immediate water and air permeability.
Preferably the under layer is more hydrophilic than
the upper layer.

15 BRIEF DESCRIPTION OF THE DRAWING

Fig. 1 shows a sectional view of a recording medium according to the present invention.

20 DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawing, there is shown an
embodiment of the recording medium comprising a
substrate 1, an under layer 2, and an upper layer
25 3.

5 The upper layer of the present invention is made of a flexible or elastic material, and will deform to protect the recorded images corresponding to deformation of the under layer swollen by the unevaporated portion of the aqueous ink after completion of recording.

10 The upper layer may comprise a polyurethane type resin.

Preferably, the thickness of the under layer is greater than that of the upper layer.

15 The thickness of the upper layer is preferably 10 μm or less, more preferably 0.01 to 0.1 μm .

The upper layer may have powder thereon, preferably in the form of a fine-powder layer.

20 The recording medium of the present invention generally may comprise a base material as the substrate, an under layer provided on its surface and an upper layer made of a polyurethane type resin with a specific thickness, and preferably a fine-powder layer as the uppermost layer. For example, particularly preferred embodiments may include:

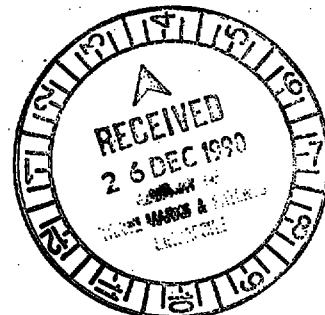
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(1) the embodiment in which the base material, the under layer and the upper layer are all transparent, and the recording medium as a whole is transparent,

5 (2) the embodiment in which at least one of the base material, the under layer and the upper layer is opaque, and the recording medium as a whole is opaque;

10 (3) the embodiment in which the base material, the under layer, the upper layer and the fine-powder layer are all transparent and the recording medium as a whole

15



1 is transparent; and

(4) the embodiment in which at least one layer of the base material, the under layer, the upper layer and the fine-powder layer are opaque and the recording
5 medium as a whole is opaque.

In any of the above cases, the under layer may also have the function of a substrate.

To describe in detail about the present invention by referring to the four kinds of preferred embodiments as mentioned above, the base material to be used
10 as the substrate in the present invention may include all of transparent and opaque base materials known in the art. Preferable examples of transparent base materials may include films or plates of polyester type
15 resins, diacetate type resins, triacetate type resins, acrylic type resins, polycarbonate type resins, polyvinyl chloride type resins, polyimide type resins, Cellophane^(R.T.M.), Celluloid, etc. and also glass plates. Preferable examples of opaque base materials may in-
20 clude papers in general, cloths, wood materials, metal plates, synthetic papers, and also those materials obtained by subjecting the above transparent base materials to the opacifying treatment according to known means. Such base materials should preferably
25 have thicknesses within the range of from about 10 to 200 μm .

In the present invention, the under layer

1 characterizing the present invention to be provided on
the above base material is formed primarily a water-
soluble or hydrophilic material which can receive an
aqueous ink. Preferable examples of such materials
5 may include natural materials such as albumin, gelatin,
casein, starch, cationic starch, gum arabic, sodium
alginate, etc., synthetic resins such as polyamide,
polyacrylamide, polyvinyl pyrrolidone, quaternized
polyvinyl pyrrolidone, polyethyleneimine, polyvinyl-
10 pyridinium halide, melamine resin, polyurethane, carbo-
xymethyl cellulose, polyvinyl alcohol, cation-modified
polyvinyl alcohol, polyester, sodium polyacrylate, etc.
Further, most preferable materials in the present inven-
tion are water-soluble resins such as polyvinyl pyrroli-
15 done, polyvinyl alcohol and/or polyacrylic resins,
which can retain an ink of several-fold of its own
weight rapidly and stably. At least one of these
materials may be used as desired.

Further, for reinforcement and/or improvement
20 of adhesion to the base material of the under layer, it
is also possible to use, in combination with the above
water-soluble resin, a resin such as SBR latex, NBR
latex, polyvinyl formal, polymethyl methacrylate, poly-
vinyl butyral, polyacrylonitrile, polyvinyl chloride,
25 polyvinyl acetate, phenol resin, alkyd resin, etc., if
desired.

As the preferable method for forming such an

1 under layer, the polymer as mentioned above, either
singly or as a mixture, may be dissolved or dispersed
in an appropriate solvent to prepare a coating liquid,
which coating liquid is then applied on said base
5 material according to the known method such as roll
coating, rod bar coating, air knife coating, spray
coating, etc., followed by drying rapidly. It is also
possible to form a single under layer from the material
as mentioned above according to the thermal spreading
10 method, the T-die method, etc. and use the under layer
while giving also the function of the substrate.
Alternatively, said sheet may be laminated on the above
substrate. Further, the above polymer material may be
subjected to hot melt coating to form an under layer on
15 the substrate.

The thickness of the under layer thus formed
may be within the range which can retain ink and is not
particularly limited, provided that it is at least 0.1
 μm , although the particular thickness employed may
20 depend on the amount of the ink to be recorded. Practi-
cally, a thickness of 0.5 to 30 μm is preferable, but
it is essentially required to be larger than the
thickness of the upper layer as hereinafter described.

The upper layer to be used in the present
25 invention, which characterized primarily the present
invention, is a thin layer made of a natural or synthe-
tic resin, particularly a thin layer made of a

1 polyurethane type resin, above all a hydrophilic poly-
urethane type resin, provided on the under layer formed
as described above. It has the function, when small
droplets are attached on its surface, of enlarging the
5 contact area rapidly (e.g. within several seconds) to
the extent that same small droplets may not excessively
overlapped with adjacent other droplets, and also pro-
moting penetration of the ink into the under layer and
reception of the ink by the under layer.

10 The present inventors have made extensive
studies in order to impart the function as mentioned
above to the under layer, and unexpectedly found that
the above function can easily be accomplished by forming
on said under layer a thin layer comprising a polymer
15 equal or inferior in hydrophilicity to the polymer
constituting the under layer. Such a function has also
been accomplished by a thin film which is completely or
substantially insoluble in water.

Particularly, when a polyurethane type resin
20 (including hydrophilic polyurethane resin insoluble in
water) is used as said polymer, such a function has
been accomplished in the case of forming a thin layer
of said polymer which is thinner than the under layer
and also in the case of forming a thin layer of said
25 polymer with a thickness of 10 μ m or less. In addi-
tion, as the result of studies with the greatest aim to
impart such a function as described above to the under

1 layer and further afford projection of a beautiful
image by OHP even immediately after printing by a color
ink jet printer, it has also been found that the above
function can easily be accomplished by providing an
5 upper layer less than 10 μm . It is surprizing enough
that such a function has been accomplished even by a
thin layer of a hydrophilic polyurethane type resin
substantially insoluble in water.

The upper layer having the function as
10 described above was accomplished by forming a thin
layer with a thickness in the range of about 10 μm or less,
preferably 5 μm or less, more preferably not more than 1 μm ,
most preferably from 0.01 to 0.1 μm with a polymer having
hydrophilic property

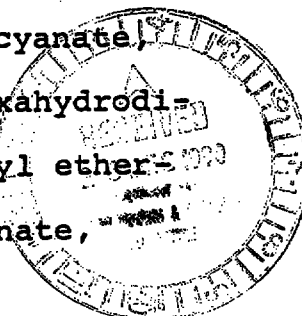
which is equal to the polymeric material forming the
15 under layer, particularly a polyurethane type resin or
a polymer which is relatively inferior in hydrophilic
property, particularly a polyurethane type resin.

As the polymeric material useful for formation
of such a thin layer, it is preferable to select one
20 equal to or inferior to the under layer in hydrophilic
property from homopolymers or copolymers of vinyl
acetate, acrylates, ethylene, vinyl chloride and other
vinyl monomers, and polymers comprising the vinyl
monomers as mentioned above and various hydrophilic
25 vinyl monomers, and further polymers such as Vinylone,
polyurethane, cellulose derivatives, polyester, poly-
amide, etc. and the hydrophilic polymers for formation

1 of the under layer as described above, either singly
or a mixture thereof.

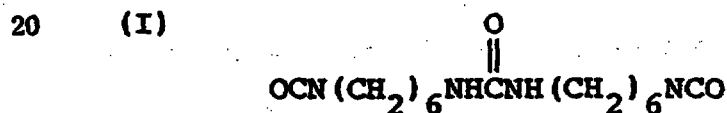
The polyurethane type resin material useful for
such a thin layer is an addition polymer of a polyiso-
5 cyanate compound and a compound having two or more
active hydrogens such as polyol, polyamine, polycarbo-
xylic acid, any of such polymers known in the art may
be available. Particularly preferable materials are
those prepared by use of NCO terminated urethane
10 prepolymers from the reaction of a polyisocyanate
compound and a polyol compound under NCO excessive
conditions, and crosslinking by polymerization with an
appropriate chain elongating agent such as water,
hydrazine, a low molecular weight polyol, a low molecu-
15 lar weight polyamide, a low molecular weight alcohol
amine, etc.

The polyisocyanate useful for formation of a
polyurethane or a urethane prepolymer may include those
having two isocyanate groups such as 1,2-diisocyanate
20 ethane, 1,2-diisocyanate propane, tetramethylene-1,4-
diisocyanate, pentamethylene-1,5-diisocyanate, hexa-
methylene-1,6-diisocyanate, nonamethylene-1,9-diisocya-
nate, decamethylene-1,10-diisocyanate, ω,ω' -dipropyl
ether diisocyanate, cyclohexane-1,4-diisocyanate,
25 dicyclohexylmethane-4,4'-diisocyanate, hexahydrodi-
phenyl-4,4'-diisocyanate, hexahydrodiphenyl ether-4,4'-
diisocyanate, phenylene-1,4-diisocyanate,

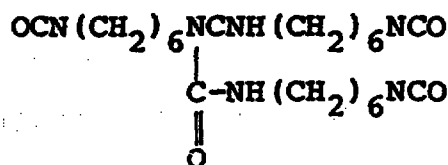


1 tolylene-2,6-diisocyanate, tolylene-2,4-diisocyanate,
 1-methoxybenzene-2,4-diisocyanate, 1-chlorophenylene
 diisocyanate, tetrachlorophenylene diisocyanate, m-
 xylylene diisocyanate, p-xylylene diisocyanate,
 5 diphenylmethane-4,4'-diisocyanate, diphenylsulfide-
 4,4'-diisocyanate, diphenylsulfone-4,4'-diisocyanate,
 diphenylether-4,4'-diisocyanate, diphenylether-3,4'-
 diisocyanate, diphenylketone-4,4'-diisocyanate,
 naphthalene-1,4-diisocyanate, naphthalene-1,5-diisocya-
 10 nate, 2,4'-biphenyl diisocyanate, 4,4'-biphenyl di-
 isocyanate, 3,3-dimethoxy-4,4'-biphenyl diisocyanate,
 anthraquinone-2,6-diisocyanate, triphenylmethane-4,4'-
 diisocyanate, and azobenzene-4,4'-diisocyanate.

15 The compounds containing 3 isocyanate groups
 may include those represented by the formulae (I) - (IV)
 and derivatives thereof, and one or more compounds may
 be chosen and used as desired for formation of a poly-
 urethane or a urethane prepolymer.

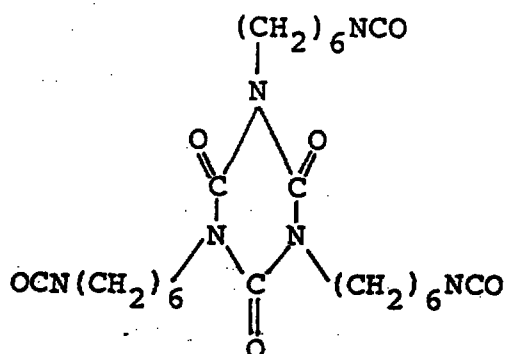


(II)



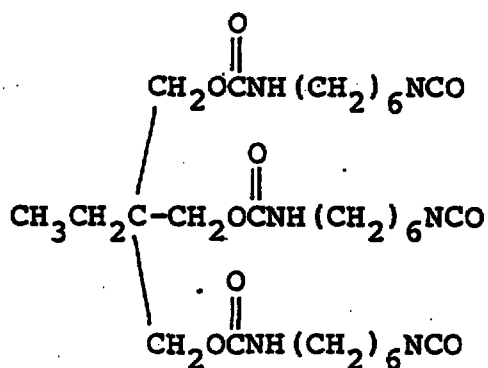
1 (III)

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10 (IV)

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The compounds having two or more active hydrogens may preferably be hydrophilic polyols, including suitably polyester polyols, polyether polyols and polyester polyether polyols. Polyester polyols are compounds produced from polybasic acids and polyhydroxy compounds, and hydroxy-terminated polyesters are preferred. As the polybasic acids, there may be employed saturated fatty acids such as oxalic acid, succinic acid, adipic acid, pimelic acid, etc., unsaturated fatty acids such as maleic acid, fumaric acid, etc., aromatic acids such as phthalic

1 acid, isophthalic acid, etc. or anhydrides thereof
either singly or as a mixture and, as polyhydroxy
compounds, one or a mixture of two or more compounds
selected from diols such as ethylene glycol, diethylene
5 glycol, triethylene glycol, propylene glycol, etc.,
triols such as trimethylolpropane, trimethylolethane,
hexane triol, glycerine, etc. and hexaols such as
sorbitol, etc.

Since such polyester polyols have generally low
10 hydrophilicity, when a hydrophilic polyurethane type
resin is desired, a compound having unsaturation is
used as a part of the starting polybasic acid to be
converted into a polyester polyol or a polyurethane,
followed by hydrophilic modification of the polymer
15 according to a known method such as introduction of
sulfonic acid groups or cationic groups or grafting of
a water-soluble monomer through utilization of the
existing unsaturation.

The polyether polyol to be used in the present
20 invention is a compound containing two or more hydroxyl
groups in one molecule and also has an ether linkage,
including homopolymers or copolymers of ethylene oxide
(EO) or propylene oxide (PO), and polyols formed by
addition of EO or PO in any desired manner to poly-
25 hydric alcohols such as glycerin, trimethylolpropane,
hexanetriol and other triols, sorbitol or other hexaols
or amines such as ethylenediamine, benzenesulfamide,

1 2-aminoethanolamine, N-methyldiethanolamine, diethylene-
triamine, amines having aromatic groups, etc., or
derivatives thereof. These may be used either singly
or as a mixture of two or more compounds. The polyester
5 polyether polyol may be obtained by condensation of the
polybasic acids and the polyether polyols as described
above so as to form terminal hydroxyl groups.

Other polyols may include castor oil, tall oil
or derivatives thereof, acrylic polyol, urethane
10 polyol, etc. Further, the low molecular weight poly-
hydric alcohols as mentioned above can also be used as
the polyol component. Besides, as a matter of course,
various polyols as described above can be used either
singly or as a mixture.

15 In the preparation of a polyurethane, the low
molecular weight polyols, the low molecular weight
diamines, the low molecular weight alcohol amines,
water or hydrazine may be used as the chain elongating
agent.

20 Preparation of the polyurethane or isocyanate-
terminated urethane prepolymer comprising the components
as mentioned above can be carried out to the known
method. As the isocyanate-terminated urethane pre-
polymer, it is of course possible to use a commercially
25 available one, for example, a prepolymer which is an
addition product of tolylene diisocyanate with various
polyester polyols or polyether polyols, having terminal

1 isocyanate groups.

Further, as the urethane polymer, a blocked urethane prepolymer stabilized by blocking of its terminal NCO groups may be used.

5 Also, the polyurethane or urethane prepolymer may be used in combination with other polymers as mentioned above, for example, homopolymers or copolymers of vinyl acetate, acrylates, ethylene, vinyl chloride and other vinyl monomers, and polymers
10 comprising the vinyl monomers as mentioned above and various hydrophilic vinyl monomers, and further polymers such as Vinylone, polyurethane, cellulose derivatives, polyester, polyamide, etc. and the hydrophilic polymers for formation of the under layer as
15 described above.

The polymers as described above may be used in the form of a solution in an organic solvent, but also in the form of an emulsion in an aqueous medium or a micro-dispersion in an organic solvent or an aqueous
20 medium. Anyway, the polymers should preferably be used as a relatively dilute solution or at such a concentration that the polymer solution gives a layer within the above range.

The upper layer may be formed with the use of
25 the materials as described above according to the same method as employed for formation of the aforesaid under layer.

1 To describe in detail, the upper layer, which
is formed by coating the resin solution as described
above to a certain thickness on the under layer,
followed by drying, should preferably be formed so that
5 micro-pores may be formed in the thin layer formed by
the treatment during drying or after drying.

Preferable methods for forming such a micro-
porous thin film may include, for example:

(1) the method for formation of a microporous layer
10 in which gas is generated through reaction with moisture
during thin layer formation as in the moisture-curable
urethane polymer, and the portions where gas was evapo-
rated remain as micro-pores in the thin layer;

(2) the method for formation of micro-pores, in
15 which an inorganic or organic fine powdery foaming
agent is mixed or dissolved into the above resin
dissolved or dispersed in a polar or non-polar solvent
and the foaming agent is permitted to foam by applying
heat during or after formation of the thin layer on
20 the under layer;

(3) the method for formation of micro-pores, in
which a relatively incompatible volatile solvent is
dispersed, emulsified or solubilized in the resin
solution to be used in (2) and evaporated during or
25 after formation of the thin layer;

(4) the method for formation of a microporous thin
film, in which a material with greater solubility in

1 the organic solvent or water than the resin in the
above resin solution, for example, a low molecular
weight material or polymer is mixed in said resin
solution, and after formation of the thin layer from
5 the resin solution, the material with great solubility
mixed therein is dissolved with an organic solvent or
water which does not impair the thin layer formed or
the ink receiving layer;

(5) the method in which a polyurethane thin layer
10 generally known as the ultra-filtration film, namely,
resin filtration film, reverse osmosis thin film, di-
alysis film, precision filtration film, etc. is lamina-
ted;

(6) the method in which an emulsion or a dispersion
15 of a polyurethane or a urethane prepolymer in an
organic solvent or water is applied by coating, and
dried at a temperature, at which the emulsion or dis-
persion particles will not be fused or excessively
fused with each other to form a layer comprising
20 polyurethane particles.

In the methods as described above, the moisture-
curable urethane prepolymer to be employed may pre-
ferably a NCO-terminated urethane prepolymer obtained
by the reaction of a polyisocyanate and a polyol under
25 NCO excess condition; the volatile solvent to be used
in another method may preferably be benzene, toluene,
acetone, lower alcohols, petroleum solvents, water,

1 etc.; inorganic or organic foaming agents may prefer-
ably be ammonium carbonate, sodium hydrogen carbonate,
ammonium nitrate, dinitrosopentamethylenetetramine,
azodicarbonamide, azobisisobutyronitrile, p-toluene-
5 sulfonyl hydrazide, 4,4'-oxy-bis(benzenesulfonyl
hydrazide), diazoaminobenzene, diphenylsulfone-3,3'-
disulfonyl hydrazide, etc.; the soluble material to be
employed in the method (4) may be either a low molecu-
lar weight material or a polymer, provided that its
10 solubility is greater than the resin for the film
forming material, and this method is particularly
suitable when the thin layer is a cured or crosslinked
film; and the particle size of the emulsion or the
dispersion to be used in the above method (6) should
15 preferably be within the range of from about 0.01 to
0.5 μm .

The upper layer comprising a polyurethane type
resin thus formed may have a thickness which may,
depending on the amount of ink required, is not parti-
20 cularly limited, if it is 10 μm or less. Practically,
a thickness in the range of from 0.1 to 5 μm is
preferred. Although it is possible to form an upper
layer by use of a material which will be swelled with
or dissolved in aqueous ink to coalesce micropores
25 after passage of the aqueous ink, it is generally
preferred to choose a material for forming the upper
layer which will not readily be swelled with or

1 dissolved in aqueous ink so that it may be provided
for use even under severe conditions of high tempera-
ture and high humidity and also the under layer may be
protected under such conditions.

5 The pore sizes of the porous upper layer as
prepared above may sufficiently be 0.2 nm or more,
since the sizes of water particles are generally con-
sidered to be 0.2 μm . However, in practical production,
the pore sizes may be varied from about 2 nm at the
10 minimum to several μm , and all of these sizes may be
suitable, but pore sizes over 100 nm will make the
layer opaque and therefore pore sizes should preferably
be not greater than 100 nm for the transparent recording
medium.

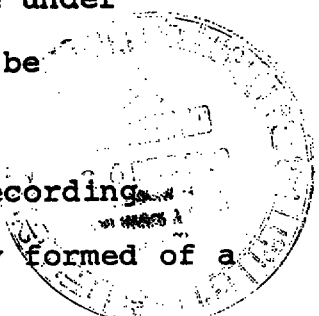
15 For formation of the upper layer by use of the
materials as described above, the same method as that
formation of the under layer may be employed. However,
when the thickness of the upper layer is required to be
in the range of 0.01 to 0.1 μm , if the thickness of the
20 upper layer exceeds 0.1 μm , the printed letter portion
will become turbid in performing recording with a large
quantity of ink, whereby the projected image of such a
recorded image by OHP, etc. will suffer from scattering
of light at the turbid portion to become dark at the
25 recorded portion of the projected image, thus failing
to give desirably inherent color formation of inks.
On the other hand, if the upper layer has a thickness

1 less than 0.01 μm , no improvement of the ink receiving
characteristic by the upper layer can disadvantage-
ously be obtained.

5 The recording medium of the present invention
having such a basic constitution as described above,
when its upper layer has a thickness less than that
of the under layer, when the thickness of the upper
layer is 10 μm or less, and when the upper layer has a
thickness of 0.01 to 0.1 μm , in spite of its hydro-
10 philicity equal or inferior to that of the under layer, is
surprisingly improved markedly in ink receiving chara-
cteristic and ink fixing characteristic as compared
with the recording medium having no such upper layer of
the prior art.

15 At present, although its theoretical ground is
not clear, it is considered that the above upper layer
does not exist necessarily as a continuous coating,
but minute voids through which aqueous ink can pene-
trate into the under layer exist in infinite number and
20 their surfaces are microscopically irregular, and
consequently the ink droplets attached can be diffused
quickly on their surfaces to enlarge the contact areas
thereof, whereby the ink absorbability by the under
layer and fixing characteristic can markedly be
25 promoted.

Also, since the upper layer of the recording
medium of the present invention is preferably formed of a



1 hydrophilic polyurethane equal or inferior in hydro-
philicity to the under layer as a thin layer with a
thickness of 0.01 to less than 0.1 μm , the ink attached
on the surface will not remain in the upper layer with
5 low ink retaining capacity, but quickly pass through
the upper layer to be retained and fixed in the under
layer with greater ink retaining capacity.

The recording medium of the present invention,
of which upper layer can be formed of a polyurethane
10 having equal or inferior in hydrophilicity to that of
the under layer, is free from contamination of instru-
ments, operator or environments through exudation of
the ink once received even in an atmosphere of high
temperature and high humidity, and also scarcely suffer
15 from tackiness of the surface under high temperature
and high humidity conditions.

Further, the powder to be used in the present
invention which characterizes further the present inven-
tion is imparted onto the above upper layer, having the
20 function of exhibiting excellent ink fixing characteris-
tic and smooth delivering characteristic when the
recording medium is applied on a printer and also
cancelling the blocking characteristic when a number
of sheets of recording medium were piled on one another.

25 The present inventors have investigated inten-
sively to have the functions as mentioned above exhibi-
ted, and consequently found that the above function

1 could be accomplished by imparting some kinds of powder
onto the upper layer.

The powder having the above function may pre-
ferably fine powder having a particle size of 20 μm or
5 less, as exemplified by inorganic powder such as silica,
clay, talc, diatomaceous earth, calcium carbonate,
calcium sulfate, barium sulfate, aluminum silicate,
synthetic zeolite, alumina, zinc oxide, lithopone,
satin white, etc., or organic powder such as higher
10 fatty acids or salts thereof (e.g. aluminum stearate,
calcium stearate, etc.), anionic, cationic, nonionic or
amphoteric surfactants which are solid at normal tem-
perature (e.g. sodium dodecylbenzenesulfonate, sodium
laurylsulfonate, potassium laurylsulfonate, sodium
15 stearylsulfonate, polyethyleneglycol nonylphenyl ether
with a relatively high HLB, etc.). Such powder may
preferably be imparted onto the upper layer at a
proportion of 0.01 to 1.0 g/cm^2 .

The materials as mentioned above can be applied
20 directly as powdery particles, or as a dispersion or a
suspension in an appropriate fluid (e.g. water). The
method for imparting the above material to the upper
layer may be, for example, dipping, brush coating,
spraying, roller coating, electrostatic adsorption, etc.

25 The preferable recording medium of the present
invention having the basic constitution as described
above is improved markedly in ink receiving characteristic,

1 ink fixing characteristic, blocking resistance, finger-
print resistance and delivering characteristic in a
printer, as compared with the recording medium having
no powder on the upper layer.

5 The powder imparted onto the upper layer, due
to a large number of voids like capillary possessed by
between particles and the particles themselves, will
enable rapid diffusion of ink through the powder by the
capillary phenomenon thereof, whereby the ink can reach
10 the upper layer with a broad area. Therefore, it is
considered that the synergistic action with the powder
imparted to the upper layer improves markedly ink
receiving characteristic, ink fixing characteristic and
delivering characteristic.

15 Further, since the powder is imparted onto the
uppermost layer, the functions considered to be impor-
tant in practical application such as no attachment of
fingerprint or no occurrence of blocking on piling of
sheets of recording medium can also be exhibited at the
20 same time.

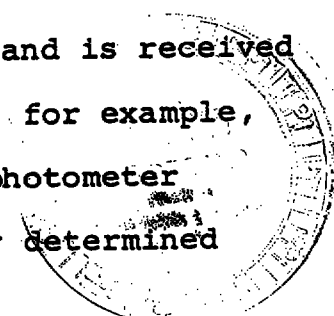
The present invention has the basic constitution
as described above and, in the embodiment of a trans-
parent recording medium, a transparent material is
employed as the substrate and it is also necessary not
25 to impair light-transmittance of the ink under layer,
the upper layer and the fine powdery layer during forma-
tion of such layers. However, to the extent which does

1 not impair their transmittance, it is also possible to
disperse a filler such as silica, clay, talc, diato-
maceous earth, calcium carbonate, calcium sulfate,
barium sulfate, aluminum silicate, synthetic zeolite,
5 alumina, zinc oxide, lithopone, satin white, etc. in
the under layer and/or the upper layer.

The sufficient light-transmittance as herein
mentioned refers to a linear transmission factor (or
straight line light transmittance) defined below which
10 exhibits at least 2 % or higher, preferably 10 % or
higher.

If the linear transmission factor is 2 % or
higher, observation of the recorded image by way of
projection on a screen, for example, by OHP may be
15 possible, and a linear transmission factor of greater
than 10 % is desirable for enabling clear observation
of the minute portions of the recorded image.

The linear transmission factor (T %) as men-
tioned in the present invention refers to the spectral
20 transmittance of the straight line light, which enters
a sample, travels through said sample, passed through
the slit on the light-receiving side at a distance of
at least 8 cm apart from said sample on the line
elongated from the incident optical path and is received
25 at the detector, as measured by means of, for example,
Model 323 Hitachi Auto-recording Spectrophotometer
(mfd. by Hitachi Seisakusho), and further determined



1 from the measured spectral transmittance according to
the following formula with the use of Y values of the
tristimulus values of color:

$$T = Y/Y_0$$

5 T: linear transmittance factor;

Y: Y value of the sample; and

Y_0 : Y value of the control.

Thus, the linear transmission factor is relative
to the straight line light, and the method for evalua-
tion of the light transmitting characteristic of the
10 recording medium by use of linear transmission factor
is different from the methods for evaluation of light
transmitting characteristic by use of diffused light
such as diffused transmitted light (transmittance
15 inclusive also of diffused light is determined by
providing 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).

20 The problems in the instruments utilizing opti-
cal technique are caused primarily through behaviors of
straight line light, and therefore it is particularly
important to determine the linear transmission factor
of a recording medium for evaluation of the light trans-
25 mitting characteristic of the record-bearing member to
be used for these instruments.

For example, when a projected image is to be

1 observed by OHP, in order to obtain an image which can
clearly and easily be viewed with high contrast between
the recorded portion and the non-recorded portion, the
non-recorded portion at the projected image is required
5 to be light, namely the linear transmission factor to
be at a certain level or higher. According to the test
by a test chart in OHP, for obtaining an image suited
for the above purpose, the linear transmission factor
through the recording medium is required to be 2 % or
10 higher, preferably 10 % or higher in order to obtain a
sharper image, more preferably 50 % or higher. Thus,
the recording medium suited for this purpose is required
to have its linear transmission factor of 2 % or higher.

On the other hand, in embodiments of the present
15 invention in which the recording medium is opaque, an
opaque material should be used for at least one layer
of the constituent layer, namely the substrate, the
under layer, the layer and the fine powder layer.

The methods for forming the respective layers
20 in opaque embodiments are the same as in the transparent
embodiment as described above. In the opaque embodiment,
in formation of the ink under layer and the upper layer,
a large amount of the fillers as mentioned above can be
used to the extent as will not impair film forming
25 property, thereby further enhancing excellent ink
receiving characteristic and fixing characteristic.

Having described above about the present

1 invention by referring to representative embodiments of
the recording medium of the present invention, the
recording medium of the present invention is not of
course limited to these embodiments. In any of the
5 embodiments, it is also possible to include various
known additives in the under layer and/or the upper
layer, such as dispersants, fluorescent dyes, PH con-
trolling agents, defoaming agents, lubricants, pre-
servatives, surfactants, etc. Also, in the upper layer,
10 there may be further contained as the yellow discolora-
tion preventive various stabilizers, including organic
tin stabilizers such as dibutyltin maleate, dioctyltin
mercaptide, etc. or other stabilizers such as poly-
phosphite, trisnonylphenyl phosphite, etc.

15 The recording medium of the present invention
is not necessarily be required to be colorless but it
may also be a colored recording medium.

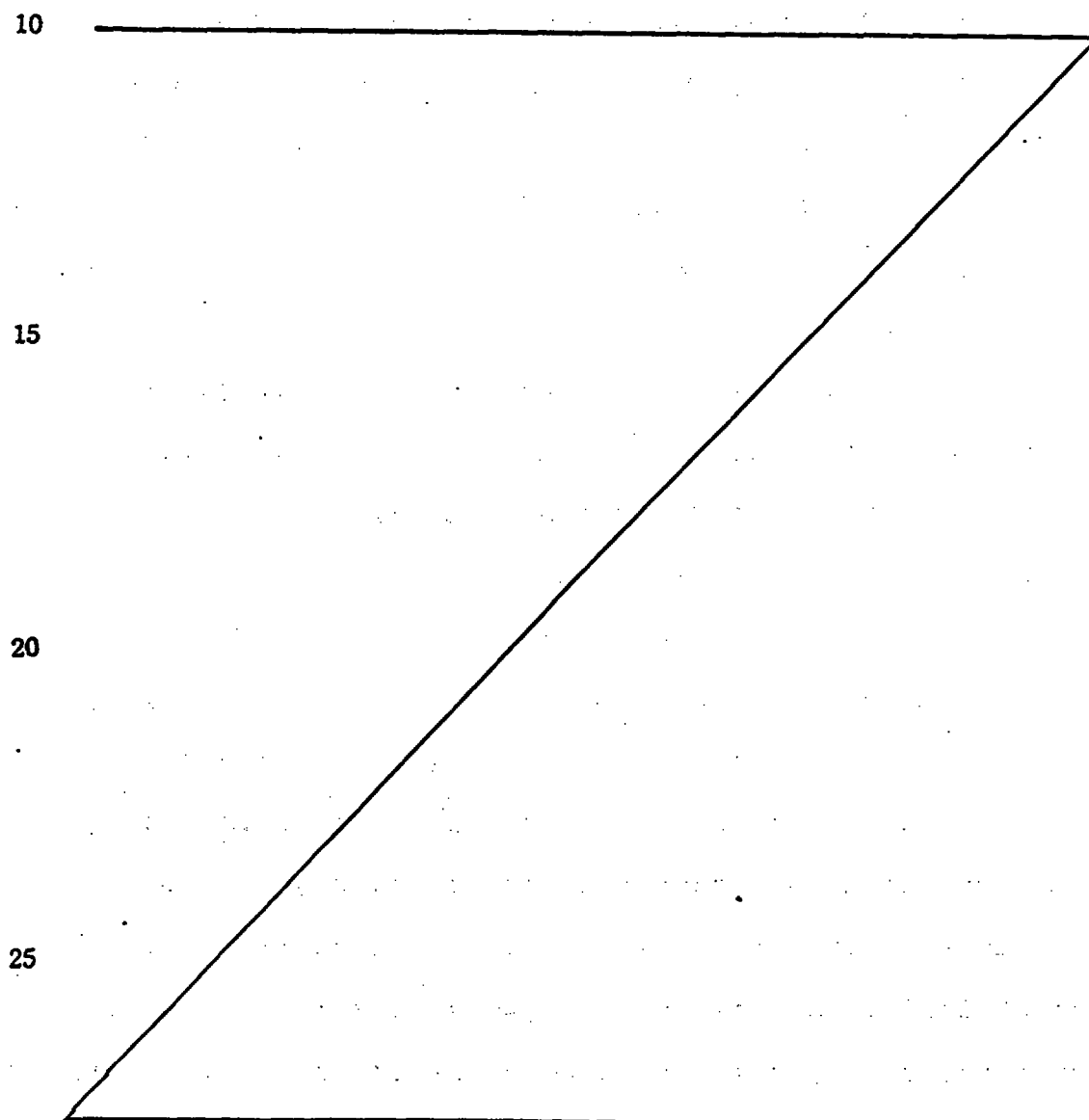
The recording medium of the present invention
as described above is markedly improved in receiving
20 and fixing of ink as verified by the Examples as here-
inafter described. For example, as a matter of course
in the case of the monochromatic color, even in
recording of full color, when recording liquids with
different colors may be attached on the same spot in
25 overlapping fashion in a short time, there is no such
phenomenon of flowing-out or exudation of the recording
liquids, and an image of high resolution is obtained

1 which is also clear and excellent in color developability. Also, when employed for observation by projection
of the recorded image onto a screen, etc. by means of
an optical instrument such as slide of OHP, since the
5 small ink droplets attached are fixed with enlargement
to the extent so as not to be overlapped with adjacent
other regions so excessively as compared with the case
of the recording medium of the prior art, the trans-
mitted light can be more uniform to give a projected
10 image with excellent uniform image density. Further,
it is also suitably applicable for uses other than
conventional surface image observation such as color
separating plates in preparation of positive plates for
color printing, CMF to be used for color display such
15 as liquid crystal, etc.

The ink used for recording on the recording
paper of this invention contains water (a solvent) and
a water-soluble dye (a colorant) as the indispensable
components. The water-soluble dye used is selected
20 widely from known direct dyes, acid dyes, and basic
dyes. Suitable contents of these colorants in the ink
are 0.5 - 30 %, preferably 1 - 20 %, by weight.
Solvents used for the ink, in addition to water, include
water-miscible solvents such as glycols, e.g. glycerol,
25 ethylene glycol, propylene glycol, diethylene glycol,
and thiodiglycol; glycol ethers, e.g. methyl carbitol,
ethyl carbitol, butyl carbitol, methyl Cellosolve, ethyl

- 1 Cellosolve, triethylene glycol monomethyl ether, and
triethylene glycol monoethyl ether; and nitrogen-
containing solvents, e.g. N-methyl-2-pyrrolidone, 1,3-
dimethyl-2-imidazolidinone, and formamide. Suitable
5 contents of water in the ink are in the range of 10 -
90 % by weight.

The method of the present invention is described
in more detail by referring to the following Examples.
The word "part" in Examples is based on weight.



1 Example 1a

As the transparent substrate, a polyethylene-terephthalate film (produced by Toray) with a thickness of 100 μm was employed, and a coating solution A
 5 having the composition shown below was applied on the film to a film thickness of 20 μm after drying by the bar coater method, followed by drying under the conditions of 60 °C and 20 minutes, to form an under layer. Then, a coating solution B shown
 10 below was applied on the under layer to a dried film thickness of 3 μm , followed by drying at 60 °C for 15 minutes to form an upper layer, thus giving a transparent recording medium of the present invention.

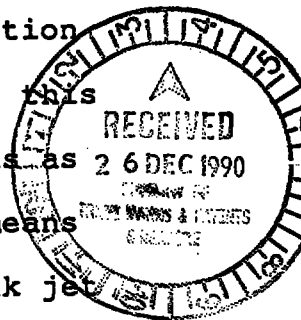
Composition of coating solution A:

15 Polyvinyl pyrrolidone K-90
 (produced by GAF) 15 parts
 Water 85 parts

Composition of coating solution B:

Carboxymethyl cellulose
 20 (Cellogen BS, produced by
 Daiichi Kogyo Seiyaku K.K.) 2 parts
 Water 98 parts

The recording medium of the present invention thus obtained was colorless and transparent. For this
 25 recording medium, by use of the four kinds of inks as shown below, ink jet recording was practiced by means of a recording device having an on-demand type ink jet



- 1 recording head which discharged ink by a piezo vibrator (discharging orifice diameter 65 μ m, driving voltage for piezo vibrator 70 V, frequency 3KHz).

Yellow ink (composition)

5	C.I. Direct Yellow 86	2 parts
	N-methyl-2-pyrrolidone	10 parts
	Diethylene glycol	20 parts
	Polyethylene glycol #200	15 parts
	Water	55 parts

10 Magenta ink (composition)

	C.I. Acid Red 35	2 parts
	N-methyl-2-pyrrolidone	10 parts
	Diethylene glycol	20 parts
	Polyethylene glycol #200	15 parts
15	Water	55 parts

Cyan ink (composition)

	C.I. Direct Blue 86	2 parts
	N-methyl-2-pyrrolidone	10 parts
	Diethylene glycol	20 parts
20	Polyethylene glycol #200	15 parts
	Water	55 parts

Black ink (composition)

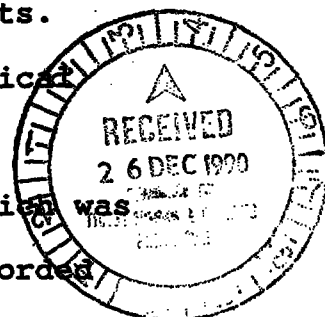
	C.I. Food Black 2	2 parts
	N-methyl-2-pyrrolidone	10 parts
25	Diethylene glycol	20 parts
	Polyethylene glycol #200	15 parts
	Water	55 parts

1 The evaluation results of the recording medium in this Example are shown in Table 1a. The respective evaluation items in Table 1a were measured according to the following methods.

5 1) Ink fixing time was determined by measuring the time until no ink was attached to fingers when the recording medium after recording was left to stand at room temperature and the recorded image was touched with fingers.

10 2) The ink dot density was measured for black dots by means of Sakura Microdensitometer PDM-5 (produced by Konishiroku Shashin Kogyo K.K.) by applying JIS K 7505 for printed letter microdots.

15 3) OHP aptitude was measured as a typical example of optical instrument 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 a clear projected image of high OD (optical density) and high contrast being rated as ○; 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 be discriminated from each other being rated as △; with the non-recorded portion which is considerably dark and the recorded image showing lines with pitch width of 1 mm and thickness of 0.3 mm which



1 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.

4) Linear transmission factor was determined
5 from the above formula (1) by measuring the spectral
transmittance by means of Model 323 Hitachi Auto-
recording Spectrophotometer (produced by Hitachi
Seisakusho) by maintaining the distance from the
sample to the window on the light-receiving side at
10 9 cm.

Example 2a

Except for using an art paper as the substrate,
according to the same method as in Example 1a, a
recording medium of the present invention was
15 prepared. This recording medium was white and opaque.
For the recording medium, the same ink jet recording
was practiced similarly as in Example 1a, and the
recording characteristics were evaluated similarly as
in Example 1a. The results are shown in Table 1a.

20 Example 3a

By use of a polyethyleneterephthalate film
with a thickness of 100 μm (produced by Teijin, Ltd.),
and a coating solution A having the composition shown
below was applied on the film to a film thickness of
25 100 μm after drying by the bar coater method, followed
by drying under the conditions of 80 °C and one hour,
to form an under layer. Then, a coating solution B

1 shown below was applied on the under layer to a
dried film thickness of 5 μ m, followed by drying at
80 °C for 20 minutes to form an upper layer. Further,
the under layer together with the upper layer were
5 peeled off from the polyethyleneterephthalate film to
give a light-transmissive recording medium of the
present invention.

Composition of coating solution A:

	Polyvinyl alcohol (PVA 420,	
10	produced by Kuraray)	10 parts
	Water	90 parts

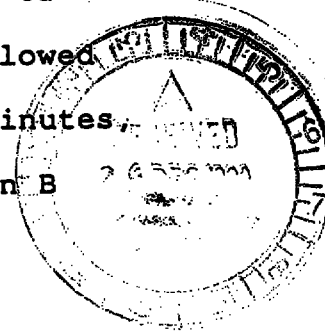
Composition of coating solution B:

	Acrylic acid ester (Dicalac	
	S 1235)	5 parts
15	Ethanol	95 parts

For the recording medium, ink jet recording
was practiced similarly as in Example 1a, and the
recording characteristics were evaluated similarly
as in Example 1a to obtain the results as shown in
20 Table 1a.

Example 4a

By use of an art paper as the substrate, a
coating solution A having the composition shown below
was applied on the substrate to a film thickness of
25 μ m after drying by the bar coater method, followed
by drying under the conditions of 50 °C and 20 minutes
to form an under layer. Then, a coating solution B



1 shown below was applied on the under layer to a dried
 film thickness of 2 μ m, followed by drying at 70 °C
 for 10 minutes to form an upper layer, thus giving a
 opaque recording medium of the present invention.

5 Composition of coating solution A:

	Water-soluble acrylic resin (Cogam	
	HW-7, produced by Showa Kobunshi	
	Co.)	20 parts
	Fine powdery silica (Siloid #244,	
10	produced by Fuji Davidson Co.)	5 parts
	Water	75 parts

Composition of coating solution B:

	Polyvinyl acetate (Movinyl 303,	
	produced by Hoechst AG)	10 parts
15	Water	90 parts

For the recording medium, the same ink jet
 recording as in Example 1a was practiced, and the
 recording characteristics were evaluated similarly
 as in Example 1a to obtain the results as shown in
 20 Table 1a.

Comparative examples 1a, 2a and 4a

Except for forming no upper layer, recording
 media for comparative purpose were prepared similarly
 as in Examples 1a, 2a and 4a, and the same ink jet
 25 recording as in Example 1a was practiced for these
 recording media. The results of evaluation of
 recording characteristics conducted similarly as in

1 Example 1a are shown in Table 1a.

Comparative example 3a

5 Except for forming no under layer, a recording medium for comparative purpose was prepared similarly as in Example 1a and the same ink jet recording as in Example 1a was practiced for this recording medium. The results of evaluation of the recording characteristics conducted similarly as in Example 1a are shown in Table 1a.

10

Table 1a

Example

<u>Ink fixing time</u>		<u>1a</u>	<u>2a</u>	<u>3a</u>	<u>4a</u>
15	20 °C, 65 % RH	1.5 min.	1.5 min.	45 sec.	1.5 min.
	20 °C, 85 % RH	1 min.	1 min.	30 sec.	45 sec.
<u>Linear transmission</u>					
	<u>factor</u>	76 %	-	78 %	-
	<u>Dot density</u>	0.9	1.2	1.0	1.0
20	<u>OHP aptitude</u>	○	-	○	-

25

1

Comparative example

	<u>1a</u>	<u>2a</u>	<u>3a</u>	<u>4a</u>
<u>Ink fixing time</u>				
20 °C, 65 % RH	3 min.	3 min.	>30 min.	10 min.
5 20 °C, 85 % RH	NR*	NR	30 min.	NR
<u>Linear transmission</u>				
<u>factor</u>	78 %	-	80 %	-
<u>Dot density</u>	0.9	1.2	1.1	1.0
<u>OHP aptitude</u>	○	-	○	-

10

*) NR means that the recorded image was sticky and no recording was possible.

Example 1b

As the transparent substrate, a polyethylene-
 15 terephthalate film (produced by Toray) with a
 thickness of 100 μm was employed, and a coating solution
 A having the composition shown below was applied on
 the film to a film thickness of 20 μm after drying
 by the bar coater method, followed by drying under the
 20 conditions of 60 °C and 20 minutes, to form an under
 layer. Then, a coating solution B shown below was
 applied on the under layer to a dried film thickness
 of 3 μm , followed by drying at 60 °C for 5 minutes to
 form a microporous upper layer, thus giving a
 25 transparent recording medium of the present invention.

1 Composition of coating solution A:

 Styrene-maleic acid monoester

 copolymer (Discoat-N-14, produced

 by Daiichi Kogyo Seiyaku) 15 parts

5 Water 85 parts

 Composition of coating solution B:

 Polyether polyurethane (Tricoat G,

 produced by Taiho Kogyo Co.) 20 parts

 Acetone 80 parts

10 The recording medium of the present invention

 thus obtained was colorless and transparent.

Example 2b

 Except for using an art paper as the substrate,

 according to the same method as in Example 1b, a

15 recording medium of the present invention was prepared.

 This recording medium was white and opaque, and the

 sizes of the micropores were the same as in Example 1b.

Example 3b

 By use of a polyethyleneterephthalate film with

20 a thickness of 100 μ m (produced by Teijin, Ltd.), a

 coating solution A having the composition shown below

 was applied on the film to a film thickness of 100 μ m

 after drying by the bar coater method, followed by

 drying under the conditions of 80 °C and one hour, to

25 form an under layer. Then, a coating solution B shown

 below was applied on the under layer to a dried film

 thickness of 1 μ m, followed by drying at 80 °C for

1 10 minutes to form an upper layer. Further, the under
 layer together with the upper layer were peeled off
 from the polyethyleneterephthalate film to give a
 light-transmissive recording medium of the present
 5 invention.

Composition of coating solution A:

Polyvinyl alcohol (PVA 220, produced by Kuraray Co.)	10 parts
Water	90 parts

10 Composition of coating solution B:

Water-dispersible urethane resin (Superflex 200, produced by Daiichi Kogyo Seiyaku Co.)	20 parts
Water	80 parts

15 Example 4b

By use of an art paper as the substrate, a
 coating solution A having the composition shown below
 was applied on the substrate to a film thickness of
 25 μm after drying by the bar coater method, followed
 20 by drying under the conditions of 50 °C and 20 minutes,
 to form an under layer. Then, a mixture of coating
 solutions B-1 and B-2 shown below at a ratio of 2 : 1
 (weight ratio) was applied on the under layer to a
 dried film thickness of 0.5 μm , followed by drying at
 25 70 °C for 5 minutes to form an upper layer, thus giving
 a recording medium of the present invention.

Composition of coating solution A:

	Water-soluble acrylic resin (Cogam HW-7, Produced by Showa Kobunshi Co.)	20 parts
5	Fine powdery silica (siloid #244, produced by Fuji Davidson Co.)	5 parts
	Water	75 parts

Composition of coating solution B-1:

10 Polyester (Desmophen 800, Bayer) 5 parts
Polyester (Desmophen 1100, Bayer) 5 parts
Solvent mixture (ethyl acetate/
methyl cellosolve/toluene=1/1/1) 90 parts

Composition of coating solution B-2:

15 Polyisocyanate (Corohate L, produced
by Nippon Polyurethane Kogyo Co.) 38 parts
Toluene 62 parts

For the recording media obtained in the above Examples 1b - 4b, by using the same four kinds of ink as in Example 1a, ink jet recording was performed similarly as in Example 1a. The recording characteristics were evaluated in the same manner as in Example 1a. The evaluation results of the recording media of Examples 1b - 4b are shown in Table 1b. Comparative examples 1b - 2b

25 Except for employing the coating solutions having the compositions shown below as the coating solution B, Example 1b was repeated to prepare recording



1 media for comparative purpose, for which the same ink
jet recording was practiced as in Examples 1b - 4b.
The evaluation results of recording characteristics
performed in the same manner as in Examples 1b - 4b
5 are shown in Table 1b.

Composition of coating solution in Comparative
example 1b:

Alkyd resin (Hariphthal COG-40-50T,
produced by Harime Kasei Co.) 10 parts
10 Xylene 90 parts

Composition of coating solution in Comparative
example 2b:

Polyaminoacid resin (Ajicoat TC-10,
produced by Ajinomoto Co.) 10 parts
15 Ethyl acetate 45 parts
Toluene 45 parts

Table 1b

	<u>1b</u>	<u>2b</u>	<u>3b</u>	<u>4b</u>
20 <u>Ink fixing time</u>				
20 °C, 65 % RH	1 min.	1 min.	1 min.	1 min.
			15 sec.	30 sec.
20 °C, 85 % RH	45 sec.	45 sec.	1 min.	1 min.
				45 sec.
<u>Linear transmission</u>				
<u>factor</u>	72 %	-	80 %	-
25 <u>Dot density</u>	0.9	1.0	1.0	1.0
<u>OHP aptitude</u>	○	-	○	-

1	<u>Comparative example</u>	
	<u>1b</u>	<u>2b</u>
	<u>Ink fixing time</u>	
	20 °C, 65 % RH	30 min. 13 min.
5	20 °C, 85 % RH	30 min. 12 min.
	<u>Linear transmission</u>	
	<u>factor</u>	76 % 80 %
	<u>Dot density</u>	0.9 1.0
	<u>OHP aptitude</u>	○ ○

10

Example 1c

As the transparent substrate, a polyethylene-terephthalate film (produced by Toray) with a thickness of 100 μm was employed, and a coating solution A having the composition shown below was applied on the film to a film thickness of 10 μm after drying by the bar coater method, followed by drying under the conditions of 60 °C and 20 minutes, to form an under layer. Then, a coating solution B shown below was applied on the under layer to a dried film thickness of 1 μm , followed by drying at 60 °C for 15 minutes to form an upper layer, thus giving a transparent recording medium of the present invention.

Composition of coating solution A:

25

Water-soluble acrylic resin (Cogam
HW-7, produced by Showa Kobunshi
Co.)

20 parts

1 Polyvinyl alcohol (PVA-420, produced
by Kuraray Co.) 5 parts
Water 75 parts

Composition of coating solution B:

5 Hydrophilic urethane resin
(Tricoat G, produced by Taiho Kogyo
Co.) 10 parts
Acetone 90 parts

The recording medium of the present invention
10 thus obtained was colorless and transparent.

Example 2c

Except for using an art paper as the
substrate, according to the same method as in Example
1c, a recording medium of the present invention was
15 prepared.

Example 3c

By use of a polyethyleneterephthalate film
with a thickness of 100 μ m (produced by Teijin, Ltd.),
a coating solution A having the composition shown
20 below was applied on the film to a film thickness of
100 μ m after drying by the bar coater method, followed
by drying under the conditions of 80 °C and one hour,
to form an under layer. Then, a coating solution B
shown below was applied on the under layer to a dried
25 film thickness of 3 μ m, followed by drying at 80 °C
for 20 minutes to form an upper layer. Further, the
under layer together with the upper layer were peeled

1 off from the polyethyleneterephthalate film to give a
light-transmissive recording medium of the present
invention.

Composition of coating solution A:

5 Polyvinyl alcohol (PVA 220, produced
by Kuraray Co.) 5 parts
Polyvinyl pyrrolidone (PVP D-90
produced by GAF) 5 parts
Water 90 parts

10 Composition of coating solution B:

Carboxymethyl cellulose (Celogen BS,
produced by Daiichi Kogyo Seiyaku
Co.) 2 parts
Water 98 parts

15 Example 4c

By use of the same material as used in Example
1c as the substrate, a coating solution A having the
composition shown below was applied on the substrate
to a film thickness of 8 μ m after drying by the bar
20 coater method, followed by drying under the conditions
of 50 °C and 20 minutes, to form an under layer. Then,
a coating solution B shown below was applied on the
under layer to a dried film thickness of 2 μ m, followed
by drying at 70 °C for 10 minutes to form an upper
25 layer, thus giving a recording medium of the present
invention.

1 Composition of coating solution A:
 Hydroxyethyl cellulose (HEC AH-15,
 produced by Fuji Chemical Co.) 5 parts
 Water 95 parts

5 Composition of coating solution B:
 Acrylic resin (Dicalac S-1235,
 produced by Daido Kasei Kogyo C.) 5 parts
 Water 95 parts

Comparative examples 1c - 2c

10 Except for forming no upper layer, recording
media for comparative purpose were prepared in the
same manner as in Examples 1c and 3c.

Comparative example 3c

 Example 1c was repeated except that the
15 thickness of the under layer was changed to 1 μ m and
the upper layer to 10 μ m to prepare a recording medium
for comparative purpose.

Comparative example 4c

 Example 4c was repeated that the thickness of
20 the under layer was changed to 2 μ m and the upper layer
to 15 μ m to prepare a recording medium for comparative
purpose.

 For the recording media of the above Examples
and Comparative examples, by using the same four
25 kinds of ink as in Example 1a, the ink jet recording
was practiced similarly as in Example 1a. The
recording characteristics were evaluated in the same

1 manner as in Example 1a.

The evaluation results of the above Examples 1c - 4c and Comparative examples 1c - 4c are shown in Table 1c.

5

Table 1c

		<u>Example</u>			
		<u>1c</u>	<u>2c</u>	<u>3c</u>	<u>4c</u>
<u>Ink fixing time</u>					
	20 °C, 65 % RH	15 sec.	15 sec.	45 sec.	15 sec.
10	20 °C, 85 % RH	15 sec.	15 sec.	45 sec.	30 sec.

Linear transmissive

<u>factor</u>	78 %	-	80 %	-
<u>Dot density</u>	0.9	1.2	1.0	1.0
<u>OHP aptitude</u>	○	-	○	

15

Comparative example

		<u>1c</u>	<u>2c</u>	<u>3c</u>	<u>4c</u>
<u>Ink fixing time</u>					
	20 °C, 65 % RH	1 min.	1 min.	3 min.	>30 min.
20	20 °C, 85 % RH	NR*	NR	15 min.	30 min.

Linear transmissive

<u>factor</u>	80 %	78 %	72 %	78 %
<u>Dot density</u>	1.0	1.0	0.8	1.0
<u>OHP aptitude</u>	○	○	○	○

25

*) NR means that no recording was possible.



1 Example 1d

As the transparent substrate, a polyethylene-
terephthalate film (produced by Toray Co.) with a
thickness of 100 μm was employed, and a coating
5 solution A having the composition shown below was
applied on the film to a film thickness of 10 μm
after drying by the bar coater method, followed by
drying under the conditions of 60 °C and 20 minutes,
to form an under layer. Then, a coating solution B
10 shown below was applied on the under layer to a
dried film thickness of 1 μm , followed by drying at
60 °C for 15 minutes to form an upper layer, thus
giving a transparent recording medium of the present
invention.

15 Composition of coating solution A:

Water-soluble acrylic resin (Cogam WH-7, produced by Shows Kobunshi Co.)	20 parts
Polyvinyl alcohol (PVA-420, produced 20 by Kuraray Co.)	5 parts
Water	75 aprts

Composition of coating solution B:

Hydrophilic urethane resin (Tricoat G, produced by Taiho Kogyo Co.)	10 parts
25 Acetone	90 parts

The recording medium of the present invention
thus obtained was colorless and transparent.

1 Example 2d

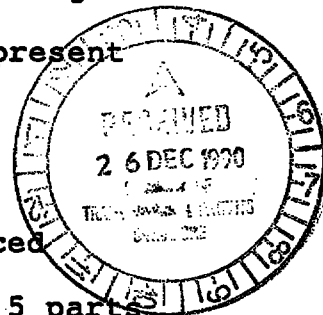
Except for using an art paper as the substrate, according to the same method as in Example 1d, a recording medium of the present invention was prepared.

5 Example 3d

By use of a polyethyleneterephthalate film with a thickness of 100 μm (produced by Teijin, Ltd.), a coating solution A having the composition shown below was applied on the film to a film thickness of 100 μm after drying by the bar coater method, followed by drying under the conditions of 80 °C and one hour, to form an under layer. Then, a coating solution B shown below was applied on the under layer to a dried film thickness of 3 μm , followed by drying at 80 °C for 20 minutes to form an upper layer. Further, the under layer together with the upper layer were peeled off from the polyethyleneterephthalate film to give a light-transmissive recording medium of the present invention.

20 Composition of coating solution A:

Polyvinyl alcohol (PVA 220, produced by Kuraray Co.)	5 parts
Polyvinyl pyrrolidone (PVP K-90 produced by GAF)	5 parts
Water	90 parts



1 Composition of coating solution B:

 Carboxymethyl cellulose (Celogen

 BS, produced by Daiichi Kogyo

 Seiyaku Co.)

2 parts

5 Water

98 parts

Example 4d

 By use of the same material as used in Example
1d as the substrate, a coating solution A having the
composition shown below was applied on the substrate
10 to a film thickness of 8 μ m after drying by the bar
coater method, followed by drying under the conditions
of 50 °C and 20 minutes, to form an under layer. Then,
a coating solution B shown below was applied on the
under layer to a dried film thickness of 2 μ m, followed
15 by drying at 70 °C for 10 minutes to form an upper
layer, thus giving a recording medium of the present
invention.

 Composition of coating solution A:

 Hydroxyethyl cellulose (HEC AH-15,

20 produced by Fuji Chemical Co.) 5 parts

 Water

95 parts

 Composition of coating solution B:

 Acrylic resin (Dicalac S-1235, produced

 by Daido Kasei Kogyo Co.)

5 parts

25 Water

95 parts

Comparative examples 1d - 2d

 Except for forming no upper layer, recording

1 media for comparative purpose were prepared in the same manner as in Examples 1d and 3d.

Comparative examples 3d - 4d

5 Examples 1d and 4d were repeated except that the thickness of the upper layer was changed to 20 μm and 15 μm , respectively, to prepare recording media for comparative purpose.

The evaluation results of the above Examples 1d - 4d and Comparative examples 1d - 4d are shown in
10 Table 1d.

Table 1d

		<u>Example</u>			
		<u>1d</u>	<u>2d</u>	<u>3d</u>	<u>4d</u>
<u>Ink fixing time</u>					
15	20 °C, 65 % RH	15 sec.	15 sec.	45 sec.	15 sec.
	20 °C, 85 % RH	15 sec.	15 sec.	45 sec.	30 sec.
<u>Linear transmission</u>					
	<u>factor</u>	78 %	-	80 %	81 %
	<u>Dot density</u>	0.9	1.2	1.0	1.0
20	<u>OHP aptitude</u>	○	-	○	○

	<u>Comparative example</u>			
	<u>1d</u>	<u>2d</u>	<u>3d</u>	<u>4d</u>
<u>Ink fixing time</u>				
20 °C, 65 % RH	1 min.	1 min.	3 min.	>30 min.
5 20 °C, 85 % RH	NR*	NR*	15 min.	30 min.
<u>Linear transmission</u>				
<u>factor</u>	80 %	78 %	70 %	78 %
<u>Dot density</u>	1.0	1.0	0.8	1.0
<u>OHP aptitude</u>	○	○	○	○

10

*) NR means that no recording was possible.

Reference example 1e

As the light-transmissive substrate, a poly-
ethyleneterephthalate film (produced by Toray) with a
15 thickness of 100 μ m was employed, and a coating
solution A having the composition shown below was
applied on the film to a film thickness of 10 μ m after
drying by the bar coater method, followed by drying
under the conditions of 60 °C and 20 minutes, to form
20 an under layer. Then, a coating solution B shown
below was applied on the under layer to a dried film
thickness of 3 μ m, followed by drying at 60 °C for
15 minutes to form an upper layer, thus giving a light-
transmissive recording medium for referential purpose.

25 Composition of coating solution A:

Polyvinyl pyrrolidone K-90 (produced
by GAF) 15 parts

1 Water 85 parts

Composition of coating solution B:

Carboxymethyl cellulose (Cellogen

BS, produced by Daiichi Kogyo

5 Seiyaku Co.) 2 parts

Water 98 parts

The recording medium of the present invention thus obtained was colorless and transparent.

Reference example 2e

10 Except for using an art paper as the substrate, according to the same method as in Reference example 1e, a recording medium for referential purpose was prepared. This recording medium was white and opaque.

Reference example 3e

15 By use of a polyethyleneterephthalate film with a thickness of 100 μ m (produced by Teijin), a coating solution A having the composition shown below was applied on the film to a film thickness of 100 μ m after drying by the bar coater method, followed by
20 drying under the conditions of 80 °C and one hour, to form an under layer. Then, a coating solution B shown below was applied on the under layer to a dried film thickness of 5 μ m, followed by drying at 80 °C for
25 20 minutes to form an upper layer.. Further, the under layer together with the upper layer were peeled off from the polyethyleneterephthalate film to give a light-transmissive recording medium for referential purpose.

1 Composition of coating solution A:

Polyvinyl alcohol (PVA 420, produced by Kuraray Co.)	10 parts
Water	90 parts

5 Composition of coating solution B:

Acrylic acid ester (Dicalac S 1235)	5 parts
Ethanol	95 parts

Reference example 4e

10 By use of an art paper as the substrate, a
coating solution A having the composition shown below
was applied on the substrate to a film thickness of
25 μ m after drying by the bar coater method, followed
by drying under the conditions of 50 °C and 20 minutes,
15 to form an under layer. Then, a coating solution B
shown below was applied on the under layer to a dried
film thickness of 2 μ m, followed by drying at 70 °C
for 10 minutes to form an upper layer, thus giving a
non-light-transmissive recording medium for
20 referential purpose.

Composition of coating solution A:

Water-soluble acrylic resin (Cogam HW-7, produced by Showa Kokunshi Co.)	20 parts
25 Fine powdery silica (Siloid #244, produced by Fuji Davidson Co.)	5 parts
Water	75 parts

1 Composition of coating solution B:

Polyvinyl acetate (Movinyl 303, produced by Hoechst AG)	10 parts
Water	90 parts

5 Example 1e

 The upper layer prepared in reference example
1e was coated by a brush with clay (particle
distribution 0.1 to 5 μm , produced by Tsuchiya
Kaolin Co.) or zeolite (particle distribution 0.5 to
10 5 μm , produced by Takeda Yakuhin Co.) to proportions
of 0.5 g/m^2 and 1.0 g/m^2 , respectively, and excessive
powder was wiped off with a cloth or a brush, to give
a transparent recording medium of the present invention.

Example 2e

15 The upper layer prepared in Reference example
2e was coated by a brush with calcium carbonate
(particle distribution 0.05 to 3 μm , produced by Nitto
Hunka Co.) or . hydrous silicon dioxide (particle size
about 15 μm , produced by Fuji Davidson Co.) to
20 proportions of 0.5 g/m^2 and 0.2 gm^2 , respectively, and
excess powder was wiped off with a cloth or a brush,
to give a recording medium of the present invention.

Example 3e

 The upper layer prepared in Reference example
25 3e was coated by a brush with anhydrous silicon dioxide
(particle size 30 $\text{m}\mu\text{m}$, produced Nippon Aerosil Co.)
or diatomaceous earth (particle size distribution

1 0.05 to 5 μm , produced by Nitto Hunka Co.) to
proportions of 0.1 g/m^2 and 0.4 g/m^2 , respectively,
and excessive powder was wiped off with a cloth or a
brush, to give a recording medium of the present
5 invention.

Example 4e

the upper layer prepared in Reference example
4e was coated by a brush with clay (particle distribu-
tion 0.1 to 5 μm , produced by Tsuchiya Kaolin Co.)
10 or calcium carbonate (particle distribution 0.05 to
3 μm , produced by Nitto Hunka Co.) to proportions of
0.8 g/m^2 and 0.5 g/m^2 , respectively, and excessive
powder was wiped off with a cloth or a brush, to
give a recording medium of the present invention.

15 For the recording media obtained in the above
Reference examples and Examples, ink jet recording
was practiced, by use of the same four kinds of inks as
in Example 1a, similarly as in Example 1a. The recording
characteristics were evaluated similarly as in Example
20 1a. The results of evaluation of Examples 1e to 4e
and Reference examples 1e to 4e are shown in Table 1e.

1

Table 1e

		<u>Example</u>			
		<u>1e</u>	<u>2e</u>	<u>3e</u>	<u>4e</u>
<u>Ink fixing time</u>					
5	20 °C, 65% RH	1 min.	1 min.	30sec.	45 sec.
	20 °C, 85% RH .	45sec.	45 sec.	20 sec.	30 sec.
<u>Linear transmission</u>					
<u>factor</u>		76 %	-	77 %	-
<u>Dot density</u>		0.9	1.2	1.0	1.0
10	<u>OHP aptitude</u>	○	-	○	-

Reference example

		<u>1e</u>	<u>2e</u>	<u>3e</u>	<u>4e</u>
<u>Ink fixing time</u>					
15	20 °C, 65% RH	1.5 min.	1.5 min.	45 sec.	1.5 min.
	20 °C, 85% RH	1 min.	1 min.	30 sec.	45 sec.
<u>Linear transmission</u>					
<u>factor</u>		76 %	-	78 %	-
<u>Dot density</u>		0.9	1.2	1.0	1.0
20	<u>OHP aptitude</u>	○	-	○	

1 Example 1f

As the transparent substrate, a polyethylene-
terephthalate film (produced by Teijin, Ltd.) with a
thickness of 100 μm was employed, and a coating solu-
5 tion A having the composition shown below was applied
on the film to a film thickness of 20 μm after drying
by the bar coater method, followed by drying under
the conditions of 60 °C and 20 minutes, to form an
under layer. Then, a coating solution B shown below
10 was applied on the under layer to a dried film thick-
ness of 3 μm , followed by hardening at 70 °C for 5
minutes to form a porous upper layer, and further by
coating of clay (Kaolin clay, produced by Tsuchiya
Kaolin Co., particle size distribution 0.1 to 5 μm)
15 at a proportion of 1.0 g/m² thereon, thus giving a
transparent recording medium of the present invention.

Composition of coating solution A:

20	Styrene-maleic acid semiester copolymer (Discoat-N-14, produced by Daiichi Kogyo Seiyaku Co.)	15 parts
	Water	85 parts

Composition of coating solution B:

25	Polyether polyurethane (Tricoat G, produced by Taiho Kogyo Co.)	20 parts
	Acetone	80 parts

The recording medium of the present invention

1 thus obtained was colorless and transparent.

Example 2f

Except for using mica (Cericite FS-1, produced
by Sanshin Koko, particle size distribution 0.5 to
5 μm) in place of the powder in Example 1f, according
to the same method as in Example 1f, a recording
medium of the present invention was prepared
(amount of powder attached 0.8 g/m^2).

Example 3f

10 Except for using anhydrous silicon oxide
(Aerofil MOX-80, produced by Nippon Aerofil Co.,
average particle size $0.03 \mu\text{m}$) in place of the powder
in Example 1f, according to the same method as in
Example 1f, a recording medium of the present invention
15 was prepared (amount of powder attached 0.1 g/m^2).

Example 4f

By use of a polyethyleneterephthalate film
with a thickness of $100 \mu\text{m}$ (produced by Teijin, Ltd.),
a coating solution A having the composition shown
20 below was applied on the film to a film thickness of
 $100 \mu\text{m}$ after drying by the bar coater method, followed
by drying under the conditions of 80°C and one
hour, to form an under layer. Then, a coating solution
B shown below was applied on the under layer to a dried
25 film thickness of $1 \mu\text{m}$, followed by drying at 80°C
for 10 minutes to form an upper layer. Subsequently,
an aqueous 5 wt. % dispersion of hydrous silicon

1 dioxide (Siloid #161, produced by Fuji Davidson Co.,
average particle size 7 μm) was attached by spraying
onto the upper layer at a proportion of 0.2 g/m^2 .
Further, the under layer together with the upper
5 layer were peeled off from the polyethyleneterephthalate
film to give a transparent recording medium of the
present invention.

Composition of coating solution A:

10 Polyvinyl alcohol (PVA 220, produced 10 parts
by Kuraray Co.)
Water 90 parts

Composition of coating solution B:

Water-dispersible urethane resin 20 parts
(Superflex 200, produced by Daiichi
Kogyo Seiyaku)
15 Water 80 parts

Example 5f

Example 4f was repeated except that calcium
carbonate (Newlight F, produced by Nitto Hunka Co.,
20 particle size distribution 0.05 to 3 μm) was employed
in place of the powder in Example 4f to obtain a
recording medium of the present invention (amount of
powder attached 0.5 g/m^2).

Example 6f

25 Example 4f was repeated except that diatomaceous
earth (Radiolight, produced by Showa Kagaku Kogyo Co.,
particle size distribution 0.5 to 5 μm) was employed

1 in place of the powder in Example 4f to obtain a
recroding medium of the present invention (amount
of powder attached 0.4 g/m^2).

Comparative examples 1f - 2f

5 Examples 1f and 4f were repeated except that
no powder was imparted to prepare recording media for
comparative purpose.

For the recording media obtained in Examples
1f - 6f and Comparative examples 1f - 2f, by use of
10 the same four kinds of ink as employed in Example
1a, the same ink jet recording was practiced similarly
as in Example 1a, and their recording characteristics
were evaluated similarly as in Example 1a. In addition,
delivering characteristic, fingerprint resistance and
15 blocking resistance were also evaluated according
the methods as described below.

The evaluation results of Examples 1f - 6f
and Comparative examples 1f - 2f are shown in Table
1f.

20 (i) Delivering characteristic: the recording
medium was cut into A4 sizes and applied to an ink
jet printer (Canon A 1210) and the number until the
recording meidum became unmovable before completion
of printing of A4 sizes was counted for evaluation;

25 (ii) Fingerprint resistance: ten fingers of
both hands were pressed against the recorded surface
of the recording medium, and the number of fingerprints

1 remained on the surface was counted for evaluation;

(iii) Blocking resistance: the recording medium was cut into A4 sizes, of which 50 sheets were piled and a plate was placed thereon under loading of 10 kg, followed by leaving to stand in a room for one month, and thereafter the load was removed for observation of blocking; those without any blocking are represented by ○, while those with blocking by X.

10

Table 1f

Example

	1f	2f	3f	4f	5f	6f
<u>Ink fixing time</u>						
20 °C, 65% RH	30 sec.	40 sec.	35 sec.	50 sec.	40 sec.	45 sec.
<u>Linear trans-</u> <u>mission factor</u>	70%	70%	68%	78%	76%	80%
<u>Dot density</u>	0.9	1.0	1.0	1.1	1.2	1.1
<u>OHP aptitude</u>	○	○	○	○	○	○
<u>Delivering</u> <u>characteristic</u>	0	0	0	0	0	0
<u>Fingerprint</u> <u>resistance</u>	1	0	0	0	1	0
<u>Blocking</u> <u>resistance</u>	○	○	○	○	○	○

20

25

		<u>Comparative example</u>	
		<u>1f</u>	<u>2f</u>
1	<u>Ink fixing time</u>		
	20 °C, 65% RH	1 min.	1 min. 15 sec.
5	<u>Linear transmission factor</u>	72%	80%
	<u>Dot density</u>	0.9	1.0
	<u>OHP aptitude</u>	○	○
	<u>Delivering characteristic</u>	> 50	> 50
10	<u>Fingerprint resistance</u>	10	10
	<u>Blocking resistance</u>	X	X

Example 1g

15 As the transparent substrate, a polyethylene-terephthalate film (produced by Toray Co.) with a thickness of 100 μm was employed, and a coating solution A having the composition shown below was applied on the film to a film thickness of 10 μm

20 after drying by the bar coater method, followed by drying under the conditions of 80 °C and 10 minutes, to form an under layer. Then, a coating solution B shown below was applied on the under layer to a dried film thickness of 1 μm , followed by curing at

25 60 °C for 5 minutes and then drying at 110 °C for one minute to form a microporous upper layer. Further, on the upper layer, Aerozil R-972 (anhydrous silicon

1 dioxide, produced by Nippon Aerosil Co., average
particle size 16 μ m) was applied at a proportion
of 0.1 to 0.2 g/m² to obtain a transparent recording
medium of the present invention.

5

Composition of coating solution A:

	Polyvinyl alcohol (PVA-420, produced by Kuraray Co.)	5 parts
	Polyacrylic acrylate (Cogam HW-7, produced by Showa Kobunshi Co.)	20 parts
10	Water	75 parts

Composition of coating solution B:

	Hydrophilic polyurethane (Tricoat G, produced by Taiho Kogyo Co.)	10 parts
	Yellow discoloration preventive (CHELEX-90, produced by Sakai Kagaku Co.)	1 part
15	Acetone	89 parts

The recording medium of the present invention
thus obtained was colorless and transparent.

Example 2g

20 According to the same procedure as in Example
1g, except for changing the composition of the coat-
ing solution A as follows, a recording medium of the
present invention was obtained.

Composition of coating solution A;

25

	Polyvinyl alcohol (PVA 220, produced by Kuraray Co.)	5 parts
	Polyvinyl pyrrolidone (PVPK-90, produced by GAF)	5 parts

1 Water 90 parts

Example 3g

By use of a polyethyleneterephthalate film with a thickness of 100 μm (produced by Teijin, Ltd.), a coating solution A having the composition shown below was applied on the film to a film thickness of 100 μm after drying by the bar coater method, followed by drying under the conditions of 80 °C and one hour, to form an under layer. Then, a coating solution B shown below was applied on the under layer to a dried film thickness of 1 μm , followed by drying at 80 °C for 10 minutes to form an upper layer. Further, the ink retaining layer together with the upper layer were peeled off and then coated with Aerosil 300 (7 $\text{m}\mu\text{m}$) by a brush at a proportion of 0.2 g/m^2 to obtain a light-transmissive recording medium of the present invention.

Composition of coating solution A:

20 Polyvinyl alcohol (PVA 220, produced by Kuraray Co.) 10 parts
Water 90 parts

Composition of coating solution B:

Water-dispersible urethane resin (Superflex 200, produced by Daiichi Kogyo Seiyaku Co.) 20 parts
25 Water 80 parts

Example 4g

By use of an art paper as the substrate, a

1 coating solution A having the composition as shown
below was applied to a film thickness of 25 μm , after
drying on the substrate according to the bar coater
method, followed by drying under the conditions
5 of 50 °C and 20 minutes, to form an under layer.
Then, the coating solution B-1 and B-2 shown below
were mixed at a ratio of 2:1 (weight ratio) and
applied to a dried film thickness of 0.5 μm , followed
by heating drying at 70 °C for 5 minutes to form an
10 upper layer. Subsequently, Aerosil MOX 170 (15 μm)
was applied at a proportion of 0.1 g/m^2 to give a
recording medium of the present invention.

Composition of coating solution A:

15	Water-soluble acrylic resin (Cogam HM-7, produced by Showa Kobunshi Co.)	20 parts
	Fine powdery silica (Siloid 244, produced by Fuji Davidson Co.)	5 parts
	Water	75 parts

Composition of coating solution B-1:

20	Polyester (Desmophen 800, Bayer)	5 parts
	Polyester (Desmophen 1100, Bayer)	5 parts
	Solvent mixture (ethyl acetate butyl acetate/methyl Cellosolve/ toluene = 1/1/1/1)	90 parts

Composition of coating solution B-2:

25	Polyisocyanate (Coronate L, produced by Nippon Polyurethane Kogyo Co.)	38 parts
	Toluene	62 parts

1 For the recording media obtained in the above
Examples 1g - 4g, by using the same four kinds of
ink as in Example 1a, ink jet recording was performed
similarly as in Example 1a. The recording charac-
5 teristics were evaluated in the same manner as in
Example 1a. The evaluation results of the recording
media of Examples 1g - 4 g are shown in Table 1g.
Comparative examples 1g

By use of a 100 μ m thick polyethylene-
10 terephthalate film (produced by Toray Co.) as the
light-transmissive substrate, a coating solution A
as shown below was applied by the bar coater method
to a film thickness after drying of 15 μ m, followed
by drying at 80 °C for 15 minutes to obtain a trans-
15 parent recording medium.

Composition of coating solution A:

Polyvinyl alcohol (PVA-220,
produced by Kuraray)

10 parts

Water

90 parts

20 For this recording medium, the same ink jet
recording was practiced similarly as in Example 1g
and the recording characteristics were evaluated
similarly as in Example 1g to obtain the results as
shown in Table 1g.

25 Comparative example 2g

Comparative example 1g was repeated except
for changing the composition of the coating solution

1 A as follows:

Coating solution composition:

5 Gelatin (Heptide DBF, produced by 5 parts
by Nippi Co.)
Water 95 parts

For this recording medium, the same ink jet recording was practiced similarly as in Example 1g and the recording characteristics were evaluated similarly as in Example 1g to obtain the results as shown in Table 1g.

Table 1g

		<u>Example</u>			
		<u>1g</u>	<u>2g</u>	<u>3g</u>	<u>4g</u>
<u>Ink fixing time</u>					
15	20 °C, 65% RH	< 5 sec.	< 5 sec.	15 sec.	30 sec.
	20 °C, 85% RH	< 5 sec.	< 5 sec.	10 sec.	20 sec.
<u>Linear trans- mission factor</u>		76%	78%	76%	77%
<u>Dot density</u>		0.8	0.8	0.8	0.8
20	<u>OHP aptitude</u>	○	-	○	○

Comparative example

		<u>1g</u>	<u>2g</u>
<u>Ink fixing time</u>			
	20 °C, 65% RH	3 min.	10 min.
25	20 °C, 85% RH	10 min.	20 min.
<u>Linear trans- mission factor</u>		82%	74%
<u>Dot density</u>		1.2	1.1

1 OHP aptitude

Examples 1h - 4h

By use of a polyethyleneterephthalate film with a thickness of 100 μ m (produced by Toray Co., Q 80) as the transparent layer, aqueous 10 % solutions of compositions for formation of under layers as shown in Table 1h shown below were applied thereon according to the bar coater method to the thicknesses as shown in Table 1h, followed by drying under the conditions of 120 °C and 3 minutes. Then, on the under layers, 1 % acetone solutions of the compositions for formation of upper layers shown in Table 1h were applied on the upper layers according to the bar coater method to the thicknesses as shown in Table 1h, followed by drying under the conditions of 100 °C and one minute. Further, the fine powder layers as shown in Table 1h in proportions as shown in Table 1h were attached by spraying to give the transparent recording media of the present invention.

20 Comparative examples 1h and 2h

Examples 1h and 3h were repeated except that no upper layer was provided in Examples 1h and 3h to obtain recording media for comparative purpose. Comparative examples 3h and 4h

25 Examples 1h and 2h were repeated except that the thickness of the upper layer was made 1 μ m in Examples 1h and 2h to obtain recording media for

1 comparative purpose.

Comparative example 5h

Example 1h was repeated except that the thickness of the upper layer was made 0.005 μm in Example
5 1h to obtain a recording medium for comparative purpose.

For the recording media obtained in the above Examples 1h - 4h and Comparative examples 1h - 5h, by use of the four kinds of inks as shown below,
10 ink jet recording was practiced by means of a recording device having an on-demand type ink jet recording head which discharged ink by a piezo vibrator (discharging orifice diameter 60 μm , driving voltage for piezo vibrator 70 V, frequency 3KHz).

15 Yellow ink (composition)

C.I. Direct Yellow 86	2 parts
Diethylene glycol	20 parts
Polyethylene glycol #200	10 parts
Water	70 parts

20 Magenta ink (composition)

C.I. Acid Red 35	2 parts
Diethylene glycol	20 parts
Polyethylene glycol #200	10 parts
Water	70 parts

25 Cyan ink (composition)

C.I. Direct Blue 86	2 parts
Diethylene glycol	20 parts

1	Polyethylene glycol #200	10 parts
	Water	70 parts
	Black ink (composition)	
	C.I. Food Black 2	2 parts
5	Diethylene glycol	20 parts
	Polyethylene glycol #200	10 parts
	Water	70 parts

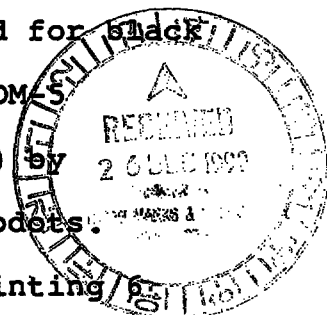
The evaluation results of the recording medium in this Example are shown in Table 2h. The respective evaluation items in Table 2h were measured according to the following methods.

1) Ink fixing time was determined by measuring the time until no ink was attached to fingers when the recording medium after recording was left to stand at room temperature and the recorded image was touched with fingers.

2) , The ink dot density was measured for black dots by means of Sakura Microdensitometer PDM/S (produced by Konishiroku Shashin Kogyo K.K.) by applying JIS S 7505 for printed letter microdots.

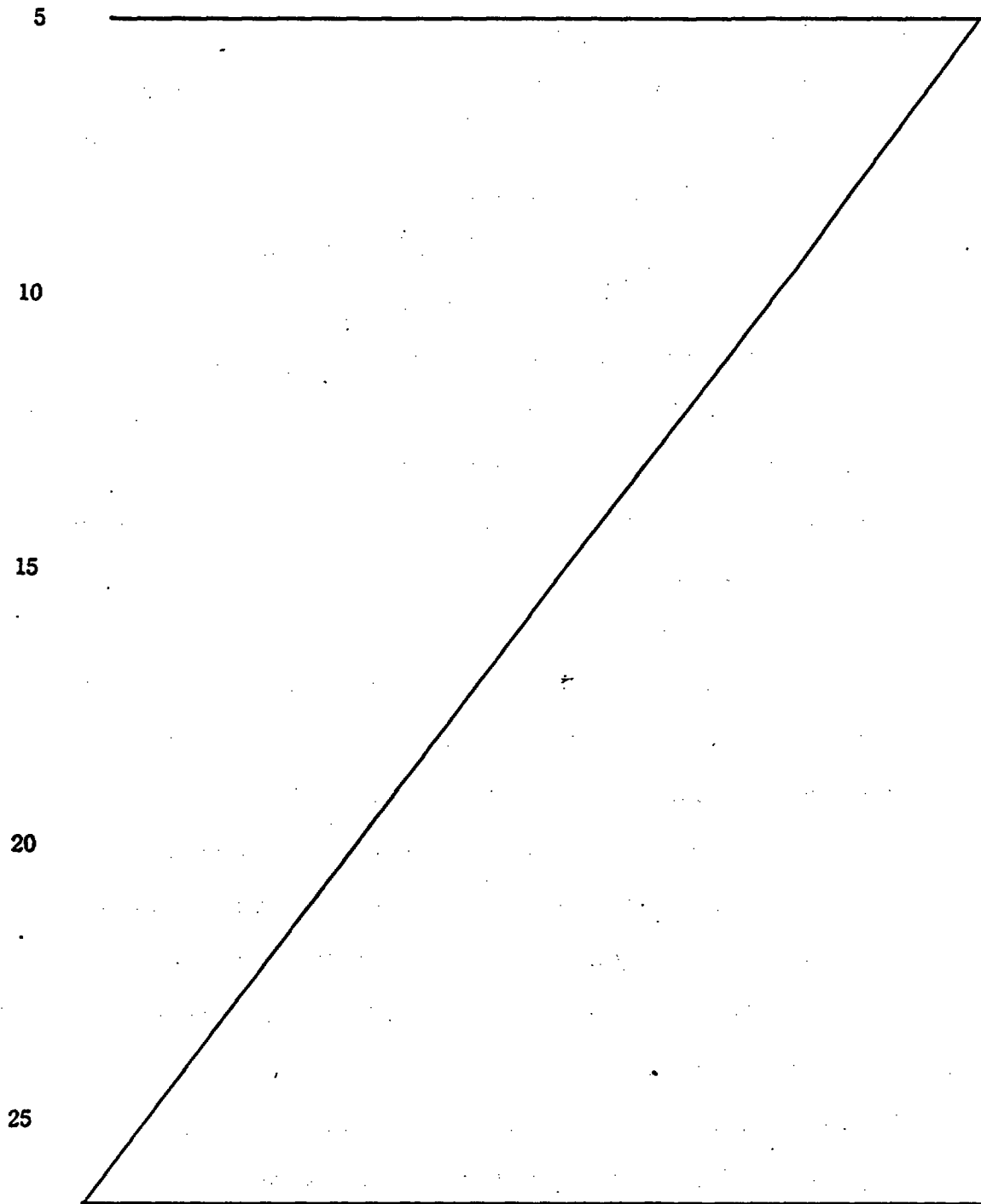
3) OHP aptitude was measured by printing dots each for the same spot and observing the recorded image projected on the screen by OHP with eyes for evaluation of the white turbidity and the optical aptitude at the printed letter portion.

○ : light at the portion to be recorded,
with high OD (optical density) at the recorded image,



- 1 giving projected images excellent in color developing with contrast and clearness;

X : dark at the printed letter portion, being inferior in color developing and clearness;



1 Δ : medium between $\bigcirc$ and X.

4) Linear transmission factor
determined from the above formula (1) by measuring
the spectral transmittance by means of Model 323
5 Hitachi Auto-recording Spectrophotometer produced
by Hitachi Seisakusho) by maintaining the distance
from the sample to the window on the light-receiving
side at 9 cm.

Table 1h

10		<u>Under layer</u>		<u>Upper layer</u>		<u>Fine powder</u>	
		<u>Composi- tion</u>	<u>Thick- ness</u> (μ m)	<u>Composi- tion</u>	<u>Thick- ness</u> (μ m)	<u>Composi- tion</u>	<u>Amount attached</u> (g/m ²)
	Example 1h	PVA-220/ PVPK-90= 1/1	6	Tricoat G	0.07	Aerosil MOX-80	0.1
15	Example 2h	PVA-200/ PVPK-90= 1/1	6	Diboncoat A	0.08	Aerosil R-97	0.05
	Example 3h	PVA-220/ HW-7=1/1	8	Tricoat G	0.09	Aerosil MOX-80	0.05
	Example 4h	PVA-200/ HW-7=1/1	6	Diboncoat A	0.04	Aerosil	0.1

20 Remarks:

*PVA: polyvinyl alcohol (produced by Kuraray)

*PVP: polyvinyl pyrrolidone (produced by GAF)

*HW: water-soluble acrylic resin
(trade name Cogam, produced by
Showa Kobunshi Co.)

25 *Tricoat G, Diboncoat A: hydrophilic poly-
urethane (produced
by Taiho Kogyo Co.)

*Aerosil: fine powdery silica (produced by
Nippon Aerosil Co.).

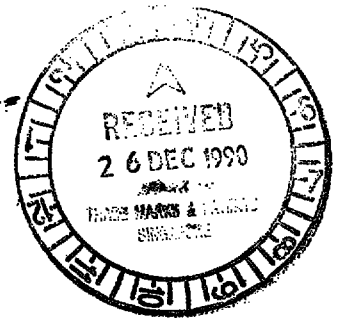
Table 2h

	<u>Ink fixing characteristic</u>		<u>Dot density</u>	<u>OHP aptitude</u>	<u>Linear trans- mission factor evaluation</u>	<u>Overall</u>
	<u>20 °C</u>					
	<u>65 % RH</u>	<u>85 % RH</u>				
Example 1h	within 10 sec.	within 10 sec.	0.8	○	78%	○
Example 2h	within 10 sec.	within 10 sec.	0.8	○	78%	○
Example 3h	within 10 sec.	within 10 sec.	0.8	○	76%	○
Example 4h	within 30 sec.	within 20 sec.	0.8	○	77 %	○
Comparative example 1h	1 min.	tacky & NR*	0.8	△	80%	x
Comparative example 2h	within 10 sec.	within 10 sec.	0.8	△	80%	x
Comparative example 3h	within 10 sec.	within 10 sec.	0.8	x	77%	x
Coimparative example 4h	within 10 sec.	within 10 sec.	0.8	x	76%	x
Comparative example 5h	1 min.	3 min.	0.8	x	80 %	x

*) NR means that no recording was possible.

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The words "CELLOSOLVE", "AJICOAT", "CELLOGEN",
"AEROSIL" and "DESMOPHEN" used herein are Trade
Marks.





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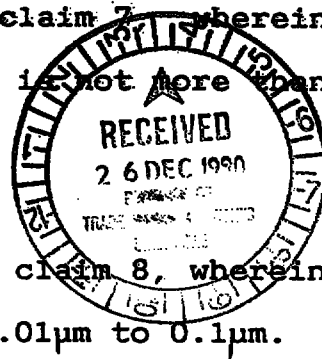
CLAIMS:

1. An ink-jet printing process in which aqueous ink droplets are propelled onto a recording medium comprising a substrate having thereon a water-sorptive under layer covered by an upper layer of substantially water-resistant polymeric material which is sufficiently thin to provide immediate water and air permeability.
2. A process according to claim 1, wherein the aqueous ink contains a water-miscible organic solvent.
3. A recording medium suitable for recording with aqueous ink without direct contact with a recording member, comprising a substrate having thereon a water-sorptive under layer covered by an upper layer of substantially water-resistant polymeric material which is sufficiently thin to provide immediate water and air permeability.
4. A recording medium according to claim 3, wherein the upper layer comprises a polyurethane resin.



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5. A recording medium according to claim 3 or 4, wherein the under layer is thicker than the upper layer.
- 5 6. A recording medium according to claims 3, 4 or 5, wherein the thickness of the upper layer is not more than 10 μm .
7. A recording medium according to claim 6, wherein
10 the thickness of the upper layer is not more than 5 μm .
8. A recording medium according to claim 7 wherein
the thickness of the upper layer is not more than
15 1 μm .
9. A recording medium according to claim 8, wherein
the upper layer has a thickness of 0.01 μm to 0.1 μm .
- 20 10. A recording medium according to claims 3 to 9, wherein the under layer comprises a hydrophilic resin.





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11. A recording medium according to any of claims 3 to 10, wherein the upper layer comprises a hydrophilic water-insoluble resin.

5 12. A recording medium according to any of claims 3 to 11, wherein the upper layer comprises a polyurethane resin.

10 13. A recording medium according to any of claims 3 to 12, wherein the recording medium is transparent as a whole.

15 14. A recording medium according to any of claims 3 to 12, wherein at least the substrate and/or one of the layers is opaque, and the recording medium is opaque as a whole.

20 15. A recording medium according to any of claims 3 to 12 or claim 14, wherein a powdery material is present on the surface of the upper layer.

25 16. A recording medium according to any of claims 3 to 12 or claim 14, wherein the upper layer is provided thereon with a fine-powder layer.



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17. A recording medium according to any of claims 3 to 16, wherein the upper layer contains pores, substantially all of the pores being less than 100nm in size.

5

18. A recording medium substantially as described herein with reference to any one of the Examples.

10

19. A process according to claim 1 or 2, wherein the recording medium is as claimed in any of claims 3 to 18.

