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(54) Heat-sensitive recording material.

(57) A heat-sensitive recording material including a metal layer ablatable by high intensity laser beam light, wherein said metal layer covers directly or through a subbing layer a binder layer containing at least one dye or dye precursor which can be transferred to a receptor element by heat and/or liquid through holes made by laser beam exposure in said metal layer.

EP 0 489 972 A1

1. Field of the invention

The present invention relates to a heat-sensitive recording material that may serve in the production of dye images.

2. Background of the invention

Heat-sensitive recording materials wherein by the thermal action of a high intensity laser beam pits or holes are burnt in a thin metallic film are applied in the recording of sound or optical information. The storage of information proceeds in digital form according to a common embodiment on a spinning disk. A laser beam is used to read out the formed track of holes as a sequential pattern of light reflection values that are detected electronically.

Recording and read-out operating with tellurium as ablatable metal is described e.g. in the periodical Scientific American, August 1980, p. 118-120. The use in optical disk production of a thin layer of bismuth for a high density direct read after write (DRAW) recording is described in Optica Acta, (1977), vol. 24, No. 4, 427-431.

The local removal of a thin metal layer by burning holes has not been restricted to the direct production of optical density or light reflection patterns but has been applied likewise according to published PCT patent application WO 86/00575 for the production of a stencil.

According to said PCT application a radiation-sensitive, imageable article is provided having at least one vapour-deposited colorant layer on the surface of a substrate and a vapour-deposited, graded metal/metal oxide or metal sulfide layer applied directly over the vapour-deposited colorant layer. The colorant layer or the metal layer may or may not have additional layers present on their surfaces which may consist of vapour-coated organic protective layers. The graded metal/metal oxide or metal sulfide layers are imageable by ablation when being struck by heat generating light such as of a high intensity laser beam or flash lamp. The holes made in the graded metal/metal oxide or metal sulfide layer by ablation serve as the openings of a stencil wherethrough dye can be transferred by heat onto a receptor element as illustrated in Example 5.

The dyes in the above colorant layer are applied binderless and are pre-coated with a very thin abrasion resistant, vapour-deposited organic polymer layer for direct pin-hole free vacuum deposition thereon of a metal layer . Such means in practice that already three vacuum-deposition steps with different substances have to be carried out for manufacturing the above radiation-sensitive article.

3. Summary of the invention

It is an object of the present invention to provide a heat-sensitive recording material comprising on a support a binder layer containing at least one dye or dye precursor coated from liquid medium and covered by a metal layer ablatable by light of a high intensity laser beam.

It is a particular object of the present invention to provide such recording material wherein said binder layer has been coated from an aqueous medium not involving toxic organic solvents.

Other objects and advantages of the present invention will become clear from the following description and examples.

According to the present invention a heat-sensitive recording material including a metal layer ablatable by a high intensity laser beam is provided, wherein said metal layer covers directly or through a subbing layer a binder layer containing at least one dye or dye precursor coated from aqueous or organic liquid medium, which dye or dye precursor can be transferred to a receptor element by heat and/or an aqueous liquid through holes made in said metal layer.

By "aqueous liquid" is meant a liquid essentially consisting of water, not excluding however, the presence of minor amounts of a substance or mixture of substances soluble in water, e.g. watermiscible organic solvent(s), pH controlling substances (alkali or acid) and surfactant(s).

By "organic liquid" is meant a liquid essentially consisting of an organic solvent for said dye or dye precursor, not excluding however, the presence of minor amounts of water.

By "dye" is meant in the present invention a substance absorbing visible light in at least a part of the visible spectrum (in the wavelength range of 400 to 700 nm), and/or infrared radiation (in the wavelength range of 700 to 1100 nm) and/or ultraviolet radiation (in the wavelength range of 250 to 400 nm).

Further according to the present invention a process for the recording and reproduction of information is provided which process includes the steps of :

(1) providing a heat-sensitive recording material including a metal layer ablatable by laser beam light,

wherein said metal layer covers directly or through a subbing layer a binder layer containing at least one dye or dye precursor coated from an aqueous or organic liquid medium, which dye or dye precursor can be transferred to a receptor element by heat and/or a liquid acting as a solvent for the dye or dye precursor through holes made in said metal layer, and
(2) exposing said recording material with a laser beam that is modulated digitally and which strikes the metal layer with such intensity that the metal layer is locally displaced or removed by ablation.

4. Detailed description of the invention

The metal layer of the present heat-sensitive recording material may be formed of a single metal or comprise different metals forming an eutectic mixture or alloy as described e.g. in published European patent application 0 294 173.

Preferably the metals employed in said metal layer have low toxicity, require small energy for ablating by fusion or evaporation and form films with ease by vapour deposition under vacuum conditions. The most preferred metals are In, Sn and Bi.

According to a particular embodiment the metal layer is built up by different superposed metals.

The metal layer has to be sufficiently thick and of high uniformity to prevent the removal of underlaying dye or dye precursor by heat (thermosublimation) or extraction by aqueous liquid.

The thickness of the metal layer is preferably not larger than 500 nm and more preferably in the range of 50 to 200 nm.

The ablatable metal layer is applied preferably by vapour deposition under vacuum. For example, the coating of a bismuth layer by vapour deposition proceeds under reduced pressure in the range of 10^{-2} Pa to 8×10^{-1} Pa as described in published European patent application No. 0 384 041.

The ablatable metal layer may be applied together with or may be coated with substances for increasing the recording sensitivity, e.g. substances that lower the light-reflectivity and improve the absorption of laser light. Examples of such substances are the metal oxides, sulfides and halides described e.g.in UK Patent application 2 036 597. GeS and SnS are preferred for said purpose and may be applied in a thickness depending on the wavelength of the recording light, e.g. in the range of 5 to 100 nm, as antireflection layer not disturbing the ablation of the ablatable metal layer.

The binder of the layer containing the thermally transferable dye or dye precursor may be soluble in aqueous or in organic medium.

Examples of dyes that may be applied in dispersed form in a hydrophilic polymer binder medium and in dissolved form in a hydrophobic polymer binder medium and that can be released therefrom by heat (through thermodiffusion or sublimation) are e.g. quinone-imine, azine, merocyanine and azo dyes that do not contain ionic salt groups.

Representatives of thermally transferable dyes that can be dispersed in aqueous medium are described with their structural formula in European patent application No. 90200481.1.

Examples of thermally transferable dye precursors (leuco dyes) are described in US-P 4,500,354. Said dye precursors are transformed into dyes by reaction with colourless phenol developers that may be present in a binder layer of the receptor element.

Infrared radiation absorbing substances considered as dyes for use in the present invention and that are thermally transferable are described e.g. in EP-A 316928. Ultraviolet radiation absorbing substances considered as dyes for use in the present invention and that are thermally transferable are monomers described in US-P 3,745,010 and fluorescent compounds described e.g. in US-P 4,876,234 and 4,891,351.

According to a particular embodiment the thermally transferable dye(s) or dye precursor(s) are incorporated in the binder layer in dissolved form in finely divided material known as "oil-former", described e.g. in published European patent application (EP-A) 363820, or a phthalate ester such as dibutyl phthalate or tricresyl phosphate forming a kind of oil-in-water droplet emulsion with the aqueous medium dissolving a hydrophilic binder.

According to another embodiment the dye(s) or dye precursor(s) are molecularly distributed in an organic substance or mixture of substances solid at room temperature but meltable above 50 °C which substance(s) in their turn are dispersed or dissolved in the binder of a hydrophilic polymer binder layer. Said meltable solid substance which may be thermally transferred together with the dye(s) or dye precursor(s) is known under the names "heat solvent" and "thermosolvent". Examples of thermosolvents are enumerated e.g. in US-P 3,438,776, and published European patent application 0 120 306 and in documents mentioned in Research Disclosure March 1989, item 29963.

Suitable image-receiving materials for fixing thermally transferred dyes are described e.g. in published European patent application No. 0 288 568.

In the embodiment wherein the transfer of dye proceeds with the aid of an aqueous liquid through holes made in the metal layer overlaying the dye containing layer preference is given to a dye-binder layer wherein the dye has an ionic character and is soluble in said aqueous liquid, and wherein the binder is waterpermeable.

Examples of suitable ionic dyes are e.g. sulfonated azo dyes, triphenylmethane dyes, rhodamine dyes, fluoresceine dyes, phenazine dyes, oxazine dyes and thiazine dyes, e.g. methylene blue, and all kind of dyes known from dye diffusion transfer photography wherein the dye transfer is controlled by development of silver halide. The principles of dye diffusion transfer colour photography and examples of ionic dyes releasable from a carrier group by a redox reaction in alkaline medium are described by Christian C. Van de Sande in Angew. Chem. Int. Ed. Engl. 22 (1983), 191-209.

Ionic dyes that can be transferred by diffusion using an aqueous liquid can be received and fixed on an image receiving material containing a mordant. Suitable mordants and mordant-containing hydrophilic binder layers for receiving and fixing anionic dyes are described in Research Disclosure November 1979, item 15162.

The amount of dye or dye precursor with respect to binder can vary widely but in order to obtain high optical density recording the weight ratio of dye or dye precursor to binder is preferably in the range of 80 to 95 % and the coverage at least 1 g per m^2.

According to one embodiment the binder used for incorporating the dye or dye precursor is a water-soluble hydrophilic polymer by means of which on a support a solid layer can be formed after removing the water of the aqueous coating medium. Examples of useful hydrophilic polymers are proteinaceous colloids polyvinyl alcohol and polyacrylamide.

A preferred hydrophilic polymer binder for incorporating dyes or dye precursors in the recording material according to the present invention is gelatin. The gelatin can be lime-treated or acid-treated gelatin. The preparation of such gelatin types has been described in e.g. "The Science and Technology of Gelatin", edited by A.G. Ward and A. Courts, Academic Press 1977, page 295 and next pages. The gelatin can also be an enzyme-treated gelatin as described in Bull. Soc. Sci. Phot. Japan, N^o 16, page 30 (1966).

Gelatin can, however, be replaced in part or integrallly by synthetic, semi-synthetic, or natural polymers either or not applied in dissolved or dispersed (latex) form. Synthetic substitutes for gelatin are e.g. polyvinyl alcohol, poly-N-vinyl pyrrolidone, polyacrylamide, polyacrylic acid and copolymers thereof. Natural substitutes for gelatin are e.g. other proteins such as zein, albumin and casein, saccharides, starch, and alginates. In general, the semi-synthetic substitutes for gelatin are modified natural products e.g. gelatin derivatives obtained by conversion of gelatin with alkylating or acylating agents or by grafting of polymerizable monomers on gelatin, and cellulose derivatives such as hydroxyalkyl cellulose, carboxymethyl cellulose, phthaloyl cellulose, and cellulose sulphates.

Latex polymers (dispersed polymer paricles in aqueous medium) can be used in some amount in admixture with the hydrophilic colloid binder, e.g. gelatin. Useful latex polymers are polymers known for forming a subbing layer as described in US-P 3,649,336. Examples of said latex polymers are copolymers of vinylidene chloride, e.g. copolymers of vinylidene chloride with acrylic acid ester monomers and minor amounts of vinyl monomers containing carboxylic acid acid groups, e.g. acrylic acid and/or itaconic acid monomers.

The hydrophilic colloid binder of the dye or dye precursor layer may be replaced partly or wholly by colloidal silica having an average particle size preferably lower than 50 nm.

The hydrophilic colloid binder, e.g. gelatin may be hardened to some degree to reduce its hydrophilic character and improve the mechanical strength of the dye or dye precursor containing layer. For that purpose appropriate hardening agents known for hardening gelatin are used e.g. epoxide, ethylenimine or vinylsulfone type compounds. Further useful hardening agents for gelatin are chromium salts e.g. chromium acetate and chromium alum, aldehydes e.g. formaldehyde, glyoxal, and glutaraldehyde, N-methylol compounds e.g. dimethylolurea and methyloldimethylhydantoin, dioxan derivatives e.g. 2,3-dihydroxy-dioxan, active vinyl compounds e.g. 1,3,5-triacryloyl-hexahydro-s-triazine, active halogen compounds e.g. 2,4-dichloro-6-hydroxy-s-triazine, and mucohalogenic acids e.g. mucochloric acid and mucophenoxychloric acid.

Water-insoluble hydrophobic polymers that are soluble in organic solvent(s) and that may be applied as binder material for thermally transferable dyes or dye precursors are e.g. ethyl cellulose, nitrocellulose, cellulose acetate formate, cellulose acetate hydrogen phthalate, cellulose acetate, cellulose acetate propionate, cellulose acetate butyrate, cellulose acetate pentanoate, cellulose acetate benzoate, cellulose triacetate, vinyl-type resins and derivatives, e.g. polystyrene and copolymers, e.g. copoly-(styrene/acrylonitrile) and copoly(acrylonitrile/styrene/butadiene), polyvinyl acetate optionally partially hydrolized, copoly(vinylchloride/acetate), polyvinyl butyral, copoly(vinyl butyral/vinyl acetal/vinyl alcohol, polyvinyl acetoacetal; polymers and copolymers of acrylic acid esters, e.g. polymethyl methacrylate and copoly(acrylate/styrene) resins; polyester resins; polycarbonates; polysulfones; polyphenylene oxide; organosilicones, such as polysiloxanes; epoxy resins and natural resins, such as gum arabic, and likewise modified natural binders such as modified dextrans described in unpublished European Patent Application No. 90200481.1.

It has been found experimentally by us that bismuth adheres sufficiently strong to a gelatin containing layer but for other metals and for still improving the adherence of bismuth it may be advantageous to use a hydrophobic organic binder or to apply a thin intermediary subbing layer that is also ablatable or has a sufficient permeability for transfer therethrough of the dye by heat and/or aqueous liquid treatment.

Resins for use in an intermediary layer acting as subbing layer improving the adherence of the ablatable metal layer to a hydrophilic polymer binder layer can be selected from resins known already for use in dye donor or receptor elements in thermal dye transfer by thermodiffusion or thermosublimation. The thermal sublimation dye transfer system and materials used therein are described e.g. in SPIE vol. 1075 Digital Image Processing Applications (1989), p. 172-178.

Examples of subbing resins that can be used are : cellulose derivatives like ethyl cellulose, cellulose acetate, partially hydrolyzed polyvinyl acetate, polyvinyl butyral, co(vinylidene/methyl methacrylate/itaconic acid, and modified dextran as described in European patent application No. 90200481.1, which application relates to dye donor elements for use in thermal dye sublimation transfer methods. Said resins may be applied from ecologically acceptable organic solvents such as i.a. methanol, 3-methoxypropanol, methyl ethyl ketone, ethyl acetate, acetone and tetrahydrofuran.

Said interlayer acting as subbing layer has preferably a thickness smaller than 5 μm and more preferably smaller than 1 μm.

The binder layer containing the dye or dye precursor and said interlayer may be applied by any coating technique known in the art for the production of thin binder layers.

The thickness of the binder layer containing the dye or dye precursor is preferably in the range of 0.2 to 5 μm, and more preferably in the range of 0.4 to 2.0 μm. The weight ratio of dye or dye precursor to binder is preferably between 9:1 and 1:3, more preferably between 2:1 and 1:2.

The support whereon the dye or dye precursor containing layer is coated may be any kind of sheet, ribbon or web support, e.g. made of metal, resin or paper or combinations of said materials. Preferred are flexible supports made of synthetic resin or resin coated paper, e.g. a polyethylene terephthalate polyester resin support subbed for adhering thereon a gelatin binder layer or a corona-treated polyethylene coated paper support.

The recording and reproduction of information with a recording material according to the present invention proceeds preferably with a laser beam that is modulated digitally and which strikes the metal layer with such intensity that the metal layer is locally displaced or removed by ablation. For example, a suitable light energy dosis for the ablation of a 150 nm thick bismuth layer is in the range of 100 to 200 mW per 10 μm^2 at pixeltimes smaller than 100 ns. A Nd-YAG laser emitting at 1064 nm is particularly useful for that purpose.

The thermal transfer of dye or dye precursor proceeds according to a convenient method by conveying the contacting materials between pressure rollers of which at least the roller contacting the back of the recording material is heated e.g. at a temperature in the range of 100 to 150 °C. An example of an apparatus suitable for thermal dye transfer is described in US-P 4,905,050 for the purpose of fusing fixing toner images obtained in electrophotography.

The present invention includes likewise a reproduction process, wherein after patternwise exposure of the present recording material its metal layer containing holes corresponding with uncovered parts of the layer containing a dye or dye precursor is brought into contact with an image-receiving material and by means of liquid between the contacting materials said dye or dye precursor is extracted and transferred onto said image receiving material.

The wetting of the contacting materials and transfer of dye or dye precursor may proceed with apparatus known from silver complex diffusion transfer reversal (DTR-) processing described e.g. in the book Photographic Silver Halide Diffusion Processes by André Rott and Edith Weyde - The Focal Press - London and New York (1972) p. 242-256.

The diffusion transfer is improved by heat speeding up the dissolution of dye or dye precursor. For that purpose and for obtaining an almost dry imaged image-receiving material the contacting materials are heated before leaving the diffusion transfer apparatus. Said heating proceeds advantageously between pressure exerting rollers.

The recording materials according to the present invention are useful in the production of monochrome images but likewise in the production of different dye images in registration on the same image-receiving material, hereby producing e.g. a multicolour hard copy or colour proof from digital information.

The present invention is illustrated by the following examples without however limiting it thereto. All ratios, parts and percentages are by weight unless otherwise stated.

EXAMPLE 1

Preparation of the heat-sensitive recording material

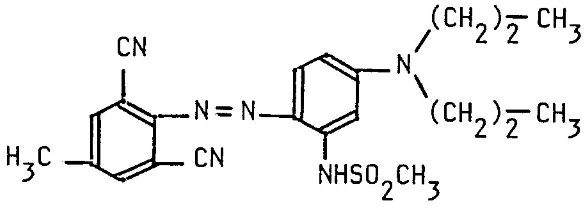
Onto a subbed polyethylene terephthalate support having a thickness of 100 µm an aqueous gelatin solution containing in a 10 % concentration RESOLIN ROT (trade name for a dye with structural formula as defined herein) was coated to form a layer with dye coverage of 2.4 g/m ^{2} in gelatin at a coverage of 1.4 g/m^2.

Onto the dried layer a 150 nm thick bismuth layer was coated by vapour deposition under reduced pressure as described in European patent application No. 89200466.4 filed 24th February 1989.

Laser beam recording

The metal layer of the above prepared recording material was subjected to ablative laser beam recording by striking the metal layer pixelwise with a laser beam of a Nd-YAG laser emitting at 1064 nm. The laser spot projected on the metal layer had a width of 6.5 um at the l/e ^{2} value of the spot intensity peak. The power of the light energy striking the metal layer was in the range of 110 to 180 mW and the writing proceeded with a pixeltime of 86 ns. By said exposure holes were burnt in the bismuth layer and the red colour of the dye could be seen in the uncovered areas.

Structure of the dye RESOLIN ROT (trade name of Bayer A.G. W-Germany)



Heat transfer

The exposed metal layer of the recording material was brought into contact with the image-receiving layer of a commercial thermal dye transfer material (HITACHI COLOR PRINT paper). The contacting materials were conveyed through the nip formed by an upper solid silicon rubber roller (diameter 4.5 cm) contacting the back of the image-receiving material and a lower hollow aluminum roller coated with a polytetrafluoroethylene layer (diameter of the coated roller 9 cm) contacting the back of the recording material. Inside the aluminum roller an infra-red radiation source serving as heating source was arranged.

The heat applied for the thermal dye transfer is controllable by the power of the infra-red radiation source and the transport speed of the contacting materials.

A practically fog free transfer of dye on the image-receiving material was obtained with a transport speed of 10 cm per second with the aluminum roller kept at 115 °C.

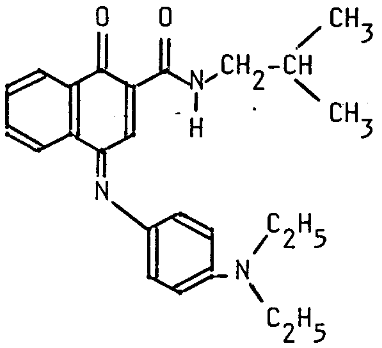
EXAMPLE 2

Preparation of the heat-sensitive recording material

Onto a subbed polyethylene terephthalate support having a thickness of 100 µm a thermally transferable cyan-blue dye having a structural formula as defined hereinafter was coated from a 10 % solution in methyl ethyl ketone of a co(styrene/allylalcohol)(79/21) serving as binder. The dry coverage of dye was equal to that of the binder and corresponded to 1 g/m^2. Onto the dried dye containing layer a subbing layer for better adherence of a vacuum deposited bismuth layer was applied from a 10 % solution in methyl ethyl ketone of co(vinylidene/methyl methacrylate/itaconic acid)(88/10/2) forming a 4 µm thick layer on drying.

Onto said subbing layer a 150 nm thick bismuth layer was coated by vapour deposition under a reduced pressure as described in published European patent application No. 0 384 041.

Structure of the thermally transferable cyan-blue dye



Laser beam recording

The metal layer of the above prepared recording material was subjected to ablative laser beam recording by exposing the metal layer pixelwise with a laser beam of a Nd-YAG laser emitting at 1064 nm. The laser spot projected on the metal layer had a width of 6.5 µm at the l/e ^{2} value of the spot intensity peak. The light energy impinging onto the metal layer was 110 mW and the writing proceeded with a pixeltime of 86 ns. By said exposure holes were burnt in the bismuth layer and the cyan-blue colour of the dye could be seen in the uncovered areas.

Solvent transfer

The exposed metal layer of the recording material was brought into contact with an image-receiving material being a polyethylene (PE) coated paper sheet having on the PE-layer a hardened gelatin layer that had been moistened with a mixture of water/ethanol(80/20 by volume). After stripping apart a cyan-blue image of extracted dye was obtained on the image-receiving material.

EXAMPLE 3

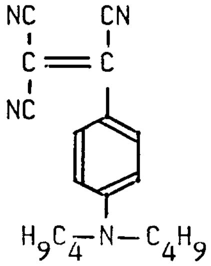
Preparation of the heat-sensitive recording material

Onto a subbed polyethylene terephthalate support having a thickness of 100 um a thermally transferable magenta dye having a structural formula as defined hereinafter was coated from a 10 % solution in methyl ethyl ketone of a copolymer of vinylacetate and vinylchloride serving as binder. The dry coverage of dye was equal to that of the binder and corresponded to 1 g/m^2.

Onto the dried dye containing layer a subbing layer for better adherence of a vacuum deposited bismuth layer was applied from a 10 % solution in methyl ethyl ketone of copoly(vinylidenechloride/methyl methacrylate/itaconic acid)(88/10/2) forming a 4 um thick layer on drying.

Onto said subbing layer a 150 nm thick bismuth layer was coated by vapour deposition under a reduced pressure as described in European patent application No. 89200466.4 filed 24th February 1989.

Structure of the thermally transferable magenta dye



Laser beam recording

The laser beam recording proceeded as described in Example 2.

Heat transfer

The heat transfer of the magenta dye proceeded as in Example 1 with the proviso however that the temperature of the heating roller was 110 °C.

Claims

1. A heat-sensitive recording material including a metal layer ablatable by a high intensity laser beam, wherein said metal layer covers directly or through a subbing layer a binder layer containing at least one dye or dye precursor.

2. Material according to claim 1, wherein said metal layer is a bismuth layer having a thickness in the range of 50 to 200 nm.

3. Material according to claim 1 or 2, wherein the dye is present in dispersed form in a hydrophilic polymer binder.

4. Material according to claim 3, wherein the binder layer contains gelatin as hydrophilic binding agent.

5. Material according to claim 1 or 2, wherein the dye is present in a hydrophobic binder soluble in (an) organic solvent(s).

6. Material according to claim 5, wherein said dye is selected from the group consisting of quinone-imine, azine, merocyanine and azo dyes that do not contain ionic salt groups.

7. A process for the recording and reproduction of information which process includes the steps of :
   (1) providing a heat-sensitive recording material including a metal layer ablatable by laser beam light, wherein said metal layer covers directly or through a subbing layer a binder layer containing at least one dye or dye precursor, and
   (2) exposing said recording material with a laser beam that is modulated digitally and which impinges onto the metal layer with such intensity that the metal layer is locally displaced or removed by ablation.

8. A process according to claim 7, wherein said metal layer is a bismuth layer having a thickness in the range of 50 to 200 nm.

9. A process according to claim 7 or 8, wherein after step (2) the metal layer containing holes is brought into contact with an image-receiving material and during said contact heat is supplied in a degree sufficient to transfer said dye or dye precursor through said holes onto said image-receiving material.

10. A process according to any of claims 7 to 9, wherein after step (2) the metal layer containing holes is brought into contact with an image-receiving material in the presence of a liquid being a solvent for the

dye or dye precursor and by means of said liquid said dye or dye precursor is transferred onto said image receiving material.

11. A process according to any of claims 7 to 10, wherein a plurality of dye images is produced in registration on the same image-receiving material.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 20 3239

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X,Y	FR-A-2621762 (THOMSON-CSF.) * page 3, line 19 - page 4, line 15 * ---	1-11	B41M5/24 B41M5/38
X,Y	PATENT ABSTRACTS OF JAPAN vol. 9, no. 183 (M-400)(1906) 30 July 1985, & JP-A-60 52390 (DAI NIPPON INSATSU KABUSHIKI KAISHA) 25 March 1985, * the whole document * ---	1-11	
X,Y	PATENT ABSTRACTS OF JAPAN vol. 13, no. 193 (M-822)(3541) 09 May 1989, & JP-A-01 16686 (TOMOEGAWA PAPER COMPANY LIMITED) 20 January 1989, * the whole document * ---	1-11	
X,Y	XEROX DISCLOSURE JOURNAL. vol. 2, no. 3, May 1977, STAMFORD, CONN US page 33 W.L.Goffe: "Flash transfer of liquid ink from a back-screened donor" * the whole document * -----	1-11	TECHNICAL FIELDS SEARCHED (Int. Cl.5) B41M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	22 JULY 1991	BACON A.J.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document