

[54] **PROCESS AND MATERIALS FOR THE
INFORMATION-WISE PRODUCTION OF
AMINO COMPOUNDS**

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[58] **Field of Search**..... **96/88, 48 R, 48 QP, 115 R,**
96/115 P, 90 R; 260/2 N; 250/316

[56]

References Cited

UNITED STATES PATENTS

3,385,809 5/1968 Wiltgen et al. 260/2 N

OTHER PUBLICATIONS

J. Chem. Soc. (1923), p. 2169.

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[57]

ABSTRACT

A recording process, wherein an amino compound is produced information-wise by the information-wise exposure to activating electromagnetic radiation and/or heat of a recording material containing in or on a support a photosensitive and/or thermosensitive amine progenitor.

15 Claims, No Drawings

PROCESS AND MATERIALS FOR THE INFORMATION-WISE PRODUCTION OF AMINO COMPOUNDS

This invention relates to a recording process and recording materials in which amino compounds are produced photolytically and/or thermolytically and to particular photosensitive and/or thermosensitive amine progenitors.

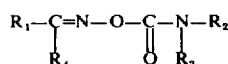
Photographic processes based on the information-wise production of acids are known, e.g. from the United Kingdom Pat. Specifications Nos. 1,070,863, 1,140,524 and the United Kingdom Patent Application No. 48,804/71. The photochemically formed acids are suited, e.g., for the production of dye images and the information-wise insolubilization of polymers by catalysis of a condensation reaction.

In organic chemistry amines are among the most important classes of compounds undergoing many and varied organic reactions. Organic amines and more especially aromatic amines are important intermediate compounds in the preparation of dyestuffs.

It is an object of the present invention to provide recording materials in which photosensitive and/or thermosensitive amine progenitors are contained that are capable of setting free an amino compound by exposure to activating electromagnetic radiation and/or heat.

It is another object of the present invention to provide a recording process in which an amino compound is set free information-wise by activating electromagnetic radiation and/or heat in a recording material and to produce by means of the amine that has been set free a chemically and/or physically detectable change.

In the process of the present invention an amine is produced information-wise by the information-wise exposure to activating electromagnetic radiation and/or heat of a recording material containing in or on a support e.g. in a solid polymeric binder a photosensitive and/or thermosensitive compound corresponding to the following general formula:



in which:

R_1 represents

1. an aliphatic group including a cycloaliphatic group and such groups in substituted form e.g. an alkyl group having a straight carbon chain or branched chain structure including a substituted alkyl group e.g. a C_1 - C_{18} alkyl group e.g. methyl, ethyl, n-propyl, isopropyl, hexyl, dodecyl, or octadecyl, an alkoxy-substituted alkyl group, an alkoxycarbonyl-substituted alkyl group e.g. a carbethoxymethyl group, an alkenyl group including a substituted alkenyl group e.g. an allyl group, a cycloalkyl group including a substituted cycloalkyl group e.g. a cyclopentyl, cyclohexyl, or methylcyclohexyl group, an aralkyl group including a substituted aralkyl group e.g. a benzyl group or phenethyl group,
2. an aryl group including a substituted aryl group, e.g. a phenyl group, a naphthyl group or a biphenyl group including these groups in substituted form, e.g. a halogen-substituted phenyl group such as 4-chlorophenyl and 3,4-chlorophenyl, alkyl-sub-

stituted phenyl e.g. a tolyl group, hydroxy-substituted phenyl, alkoxy-substituted phenyl, in which the alkyl group of the alkoxy group is e.g. a C_1 - C_{18} alkyl group, a carboxy-substituted phenyl, an esterified carboxy-substituted phenyl group e.g. a methoxycarbonyl-substituted phenyl group, a cyano-substituted phenyl group, a fluorosulfonyl-substituted phenyl group or a nitro-phenyl group,

3. a heterocyclic group including a substituted heterocyclic group, or

4. an acyl group e.g. an aliphatic or aromatic acyl group derived from a carboxylic or sulphonic acid e.g. acetyl, methylsulphonyl, benzoyl, or phenylsulphonyl,

R_2 represents

1. an aliphatic group including a cycloaliphatic group and such groups in substituted form e.g. an alkyl group having a straight carbon chain or branched chain structure including a substituted alkyl group e.g. a C_1 - C_{18} alkyl group e.g. methyl, ethyl, n-propyl, isopropyl, hexyl, dodecyl, or octadecyl, an alkoxy-substituted alkyl group, an alkoxycarbonyl-substituted alkyl group e.g. a carbethoxymethyl group, an alkenyl group including a substituted alkenyl group e.g. an allyl group, a cycloalkyl group including a substituted cycloalkyl group e.g. a cyclopentyl, cyclohexyl, or methylcyclohexyl group, an aralkyl group including a substituted aralkyl group e.g. a benzyl group or phenethyl group,

2. an aryl group including a substituted aryl group, e.g. a phenyl group, a naphthyl group or an anthryl group including these groups in substituted form, e.g. a halogen-substituted phenyl group e.g. 4-chlorophenyl and 3,4-chlorophenyl, alkyl-substituted phenyl e.g. a tolyl group, alkoxy substituted phenyl in which the alkyl group of the alkoxy group is e.g. a C_1 - C_{18} alkyl group or a dialkylamino-substituted phenyl group, or

3. a heterocyclic group including a substituted heterocyclic group,

R_3 represents

1. hydrogen,

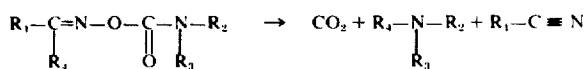
2. an aliphatic group including a cycloaliphatic group and such groups in substituted form e.g. an alkyl group having a straight carbon chain or branched chain structure including a substituted alkyl group e.g. a C_1 - C_{18} alkyl group e.g. methyl, ethyl, n-propyl, isopropyl, hexyl, dodecyl, or octadecyl, an alkoxy-substituted alkyl group, an alkoxycarbonyl-substituted alkyl group e.g. a carbethoxymethyl group, a cycloalkyl group including a substituted cycloalkyl group e.g. a cyclopentyl, cyclohexyl, or methylcyclohexyl group, an aralkyl group including a substituted aralkyl group e.g. a benzyl group or phenethyl group,

3. an aryl group including a substituted aryl group, e.g. a phenyl group or a naphthyl group including these groups in substituted form, or

4. a heterocyclic group including a substituted heterocyclic group or R_3 and R_2 form together part of a heterocyclic ring e.g. piperidine or morpholine ring, and

R_4 represents hydrogen or an aliphatic group including a cycloaliphatic group e.g. an alkyl group or a cycloalkyl group, or an aromatic group including a substituted aromatic group.

The reaction applied in the present invention may be represented by the following reaction scheme:



For example, when R_2 is an aromatic group e.g. a phenyl, naphthyl, or anthryl group including said groups in substituted state and R_3 is hydrogen aromatic amines are produced that are suited for a dye-forming reaction known to those skilled in the art.

When R_2 and/or R_3 is (are) an aliphatic or cycloaliphatic group, amines are produced that fairly strongly raise the pH of the medium. Said amines may catalyze a dye-forming reaction or effect a colour change in a pH-indicator dye.

When R_2 and R_3 form part of a ring structure, heterocyclic amines e.g. piperidine, morpholine, pyrrolidine

or cyclic amino acids, e.g. proline are set free photolytically. The cyclic amines are strongly raising the pH. The amino acids may be detected by a typical colour reaction e.g. with ninhydrin.

When R_3 is hydrogen and R_2 is a polymeric group to which the amino group is attached such as in a protein, the photolytically formed amino compound may serve to make cross-links with a cross-linking agent, e.g. a bisepoxide, and form that way an insolubilized polymer mass.

Another way to achieve image-wise cross-linking is to use an amine progenitor producing a polyfunctional amine, e.g. a diamine capable of acting as cross-linking agent e.g. with a resin containing free epoxy groups.

As an illustration of the present invention specific compounds that photolytically yield an amine are listed in the following Table with their melting point.

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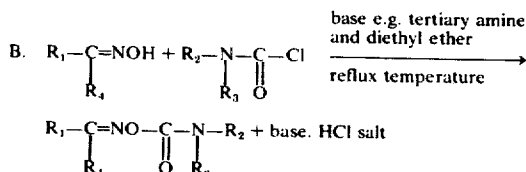
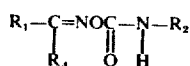
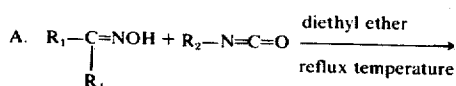
Table

Compound	Structural formula	Melting point °C
1		136
2		104
3		oil at 20°C
4		130
5		128
6		92
7		136
8		102
9		130
10		102

Table-continued

Compound	Structural formula	Melting point °C
11		120
12		oil at 20°C
13		80

The compounds used in the present invention may be prepared according to the following two reaction schemes A and B:



Compound 1 of the Table has been prepared according to Beilstein 12, 372 but may be prepared likewise according to Ber. 23, 3327 or J. Chem. Soc. (1923), 2169.

The other compounds have been prepared according to the following preparation receipts:

Preparation of compound 1

5 g of benzaloxime were dissolved in 10 ml of diethyl ether and added dropwise to a solution of 7 g of phenyl isocyanate in 20 ml of diethyl ether. The reaction mixture was kept for 1 h at room temperature. The precipitated reaction product was sucked off.

Yield: 5 g. Melting point: 136°C.

Preparation of compound 2

17 g of p-diethylaminophenylisocyanate were dissolved in 30 ml of diethyl ether and the obtained solution added to a solution of 11 g of benzaloxime dissolved in 20 ml of diethyl ether. The reaction mixture was boiled with reflux for 2 h. The precipitated reaction product was sucked off and recrystallized from a mixture of benzene and hexane (50:50 by volume).

Yield: 18 g. Melting point: 104°C.

Preparation of compound 3

6 g of benzaloxime were dissolved in 10 ml of diethyl ether and 5 g of butyl isocyanate dissolved in 10 ml of diethyl ether were added thereto. The reaction mixture was boiled with reflux for 2 h. The diethyl ether was removed by evaporation.

Yield of 4 g of oily product.

Preparation of compound 4

6 g of benzaloxime were dissolved in 10 ml of diethyl ether and 19 g of octadecyl isocyanate dissolved in 20 ml of diethyl ether were added thereto. The reaction mixture was boiled with reflux for 3 h. The diethyl ether was removed by evaporation and the reaction product recrystallized from hexane.

Yield: 15 g. Melting point: 130°C.

Preparation of compound 5

5 g of benzaloxime were dissolved in 10 ml of diethyl ether and thereto a solution containing 3.5 g of 2,4-toluene isocyanate dissolved in 20 ml of diethyl ether was added. The diethyl ether was evaporated. The reaction product was recrystallized from a mixture of hexane and benzene 50:50 by volume.

Preparation of compound 6

6 g of benzaloxime were dissolved in 10 ml of diethylether and a solution of 6.5 g of carbethoxymethyl isocyanate dissolved in 30 ml of diethyl ether were added. The reaction mixture was boiled with reflux for 3 h. The precipitated reaction product was sucked off.

Yield: 8 g. Melting point: 92°C.

Preparation of compound 7

1.2 g of benzaloxime were dissolved in 5 ml of diethyl ether and 2 ml of triethyl amine were added thereto. To the obtained mixture 1.47 g of piperidyl carbonyl chloride dissolved in 5 ml of diethyl ether were added. The reaction mixture was kept for 1 h at room temperature. The precipitate was sucked off.

Yield: 1.5 g. Melting point: 136°C.

Preparation of compound 8

2.4 g of o-nitro benzaloxime were dissolved in 10 ml of diethyl ether and 3.8 g of p-diethylamino phenyl isocyanate dissolved in 20 ml of ether added thereto. The reaction mixture was boiled with reflux for 3 h. The precipitated reaction product was sucked off.

Yield: 3 g. Melting point: 102°C.

Preparation of compound 9

5 g of p-diethylamino phenyl isocyanate were dissolved in 20 ml of diethyl ether and 3.5 g of salicylaloxime dissolved in 10 ml of ether added thereto. The obtained reaction mixture was boiled with reflux for 3 h. The precipitated reaction product was sucked off.

Yield: 5 g. Melting point: 130°C.

Preparation of compound 10

9.5 g of diethyl aminophenyl isocyanate were dissolved in 20 ml of diethyl ether and 6.5 g of phenyl acetalozone dissolved in 20 ml of diethyl ether added thereto. The obtained reaction mixture was boiled with reflux for 1 h. The precipitated reaction product was sucked off.

Yield: 8 g. Melting point: 102°C.

Preparation of compound 11

2.4 g of benzaloxime were added to a solution of 1 g of sodium hydroxide dissolved in 20 ml of water. The reaction flask containing the obtained solution was cooled down with ice water and 3 g of morpholino carbonyl chloride added dropwise thereto. The reaction mixture was stirred for a further period of 1 h.

Yield: 4 g. Melting point: 120°C.

Preparation of compound 12

2.4 g of benzaloxime were dissolved in 10 ml of diethylether and 5 ml of triethyl amine were added thereto. To the obtained mixture 3.2 g of di-propylamine carbonyl chloride dissolved in 30 ml of diethylether were added. The reaction mixture was boiled with reflux for 4 h, thereupon cooled down, filtered and the ether removed by evaporation.

Yield: 5 g of oily product.

Preparation of compound 13

3 g of acetone oxime were dissolved in 10 ml of diethyl ether and 5 ml of triethyl amine were added thereto. To the obtained mixture 9 g of diethylamino phenyl isocyanate dissolved in 30 ml of diethyl ether were added. The reaction mixture was boiled with reflux for 1 h.

The precipitated reaction product was sucked off.

Yield: 7 g. Melting point: 80°C.

The amine produced in the photolytic or thermolytic reaction can be of the type that is suited for a dye-forming reaction either as a catalyst or as a reaction partner.

For example, it is within the scope of the present invention to produce information-wise, N,N-dialkyl-p-phenylenediamine and its derivatives. These amines are well known colour developers, that find application in silver halide colour photography. In the oxidative coupling of such developers with a colour coupler dyes of the azomethine or indophenol type are formed. Suitable phenol, naphthol and active methylene type colour couplers for such oxidative coupling(s) are described by P. Glafkides — *Photographic Chemistry*, Vol. II (1960) 593-615 — Fountain Press — London.

An amine progenitor from which the setted free amine may serve as a colour developer is exemplified by compound 2 of the Table.

A recording material suited for dye image formation based on the use of such colour developer contains preferably said amine progenitor in intimate admixture with a colour coupler and an oxidant incorporated in a binder layer.

The oxidant has to be selected in order to yield a fast colour reaction in the exposed area without colouration(dye) formation) in the image background area. For that purpose m-chloroperbenzoic acid is particularly useful.

Peroxides such as dibenzoyl peroxide and p,p'-di-(tert. butyl)dibenzoyl peroxide offer a very fast dye for-

mation, however, associated with background colouration.

For the preparation of such photosensitive material the photosensitive amine progenitor(s), the coupler(s) and optionally the oxidizing agent are applied together from a solution or dispersion preferably in the presence of a film-forming binding agent to a suitable support.

As binding agent for the photosensitive layer all kinds of natural, modified natural and synthetic resins can be used, e.g. proteins such as gelatin, cellulose derivatives, e.g. a cellulose ether such as ethylcellulose, cellulose esters, carboxymethyl cellulose, alginic acid and derivatives, starch ethers, galactomannan, polyvinyl alcohol, poly-N-vinylpyrrolidone, polymers derived from α,β -ethylenically unsaturated compounds, e.g. homo- and co-vinyl polymers such as polyvinyl chloride, copolymers of vinyl chloride and vinyl acetate partially saponified polyvinyl acetate, copolymers of acrylonitrile and acrylamide, polyacrylic acid esters or polymethacrylic acid esters.

The ratio by weight of amine progenitor to binder is e.g. 1:5 to 1:50.

The recording material may consist of a self-supporting sheet or may comprise a photosensitive layer applied to a support e.g. sheetlike or ribbonlike support. Suitable supports are, e.g. supports of paper of which glassine paper is preferred, and resin supports known in silver halide photography. It is also possible to apply the photosensitive material to glass or to a support from which it can be stripped off and transferred to a permanent support.

The information-wise exposure to activating electromagnetic radiation applied in the present invention may be a contact exposure as well as an optical projection exposure as is used e.g. in an optical enlarging apparatus. The information-wise exposure need not be simultaneous in all parts of the recording material. The exposure may be progressive in a continuous step as e.g. in sound track recording or in successive intermittent steps provided that the required information-wise change is obtained. Thus, the recording material may be scanned with an image-wise modulated radiant energy spot of high intensity e.g. a laser beam, or the material may be progressively exposed through a slit e.g. exposed to copying light of a tubular lamp that is given a translation movement along the original.

The information to be recorded may be of any desirable type e.g. information in the form of images, code-marks, dots and lines, alpha-numerical writing and data in analogon form such as sound tracks.

The information-wise heating may proceed by any technique known in thermography e.g. with infra-red light absorbed in heatable image-markings, with a hot stylus or by dielectric heating.

According to a special embodiment an amino compound that has fluorescent properties or a reaction product thereof that has fluorescent properties is produced information-wise and detected by fluorescent light emission. Thus, e.g. it is possible to detect the information-wise change produced by the photolytically produced amine or its reaction product in the form of fluorescent light emitted by the amine or said reaction product.

For this purpose, after information-wise exposure to light or heat of the recording material containing the amine progenitor setting free an amine having fluorescent properties, e.g. a p-phenylene derivative, the recording material is overall exposed to light of a wave-

length range, which stimulates the fluorescence of the information-wise formed amine. The emitted fluorescent light can be separated from the fluorescence activating light with an appropriate band or cut-off filter.

The emitted fluorescent light can be detected visually or detected with an appropriate instrument such as a photocell or recorded with another photosensitive system e.g. a silver halide emulsion material.

The amount of detectable fluorescence emission is proportional to the intensity of the initial image-wise exposure. This means that as the intensity of that exposure or the exposure time increases, the amount of formed fluorescing amine per unit of exposed area increases which results in an increased differentiation in fluorescence emission characteristics.

When the information-wise exposure occurs by means of high pressure mercury vapour bulbs of 75 W exposure times of less than 90 sec. suffice.

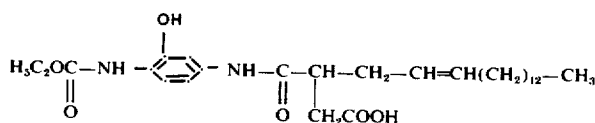
As a matter of fact by audiomodulation of the exposure radiation the materials of the present invention can be used for producing sound records. These records can then be reproduced through conventional electronic means including photocells, amplifiers, etc.

The following examples illustrate the present invention without, however, limiting it thereto. The percentages and ratios are by weight unless otherwise indicated.

EXAMPLE 1

To a baryta-coated photographic paper base a composition containing the following ingredients was applied at a coverage of 6 g per sq. m:

compound 2 of the Table

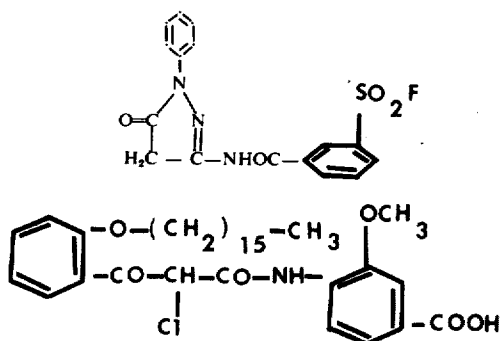


m-chloroperbenzoic acid
5% by weight solution of polymethyl
methacrylate in methylene chloride

The dried coating was contact-exposed for 5 sec. through a transparent line original with an ultra-violet lamp of 1000 W (Actina SH, trade name) placed at a distance of 10 cm.

A cyan print-out image having reversed image values with respect to the original was obtained.

By replacing the colour coupler defined above with colour couplers having respectively the following structural formulae magenta and yellow dye images were formed.



EXAMPLE 2

The photolytic formation of aniline was demonstrated in the following experiment: an ethanolic solution of compound 1 in a concentration of 1×10^{-2} mole per litre was irradiated in PYREX glass tube with a high pressure mercury vapour lamp of 100 W placed at a distance of 15 cm. After 5 min. the irradiation was stopped and sodium 1,2-naphthoquinone-4-sulphonate was added. A red dye characteristic for the presence of aniline was formed (see F. Feigl, Spot Tests in Organic Analysis; Elsevier Publ. Co. London (1966) 153).

EXAMPLE 3

In an experiment analogous to that described in Example 2 an ethanolic solution of compound 3 of the Table in a concentration of 1×10^{-2} mole per litre was irradiated for 10 min. The pH of the solution increased to about 8 during the irradiation as was demonstrated by the colour change of commercial pH-indicator paper.

EXAMPLE 4

To a cellulose triacetate film a composition containing the following ingredients was applied at a wet coating thickness of 0.15 mm:

0.001 mole of compound 2 of the Table dissolved in 5 ml of ethanol, and

5 ml of a 10 % solution of ethyl cellulose in ethanol. After drying the recording layer was image-wise exposed for 1 min. in contact with a transparent line original with a 70 W ultraviolet lamp placed at a distance of

100 mg

100 mg

40 mg

8 ml

20 cm.

The image-wise obtained amine is detected by its fluorescent properties. Thus, the recorded information is retrieved by the fluorescent light emission of the amine. For this purpose the image-wise exposed recording material is overall exposed to light of the absorption region of the formed amine i.e. here electromagnetic radiation of a wavelength of 366 nm which stimulates the emission of blue fluorescent light having a wavelength range up to 450 nm is used. The 366 nm radiation is obtained with a mercury vapour ultraviolet lamp and an appropriate band filter.

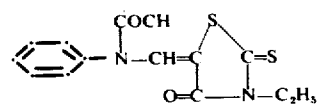
EXAMPLE 5

The coated layer of Example 1 was brought into heat-conductive contact with a paper carrying a text printed with carbon ink and contact-exposed with infrared radiation in a THERMOFAX copying apparatus, Model 47-3M (a thermographic copying apparatus of Minnesota Mining & Manufacturing Company, St. Paul, Minn., U.S.A.).

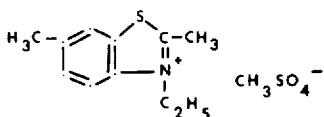
A cyan positive copy of strong density was obtained.

EXAMPLE 6

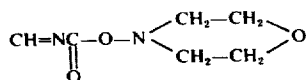
To an unsubbed polyethylene terephthalate film the following mixture was coated at a coverage of 6 g per sq.m.



100 mg



60 mg



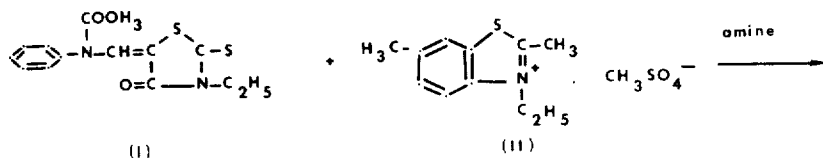
100 mg

5% by weight solution in methylene chloride of RHENOFLEX (trade-name for an after chlorinated polyvinyl chloride of Dynamit Nobel A.G. - W. Germany)

10 ml

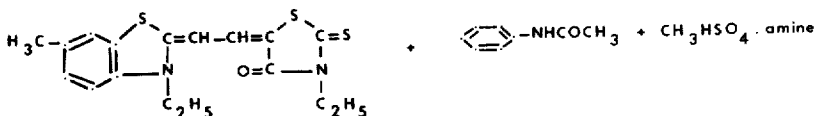
A methine dyestuff (III) having a red colour was formed by heating the obtained thermographic copying material in the THERMOFAX (trade-name) apparatus described in Example 5.

The production of the methine dye proceeds according to the following reaction scheme:



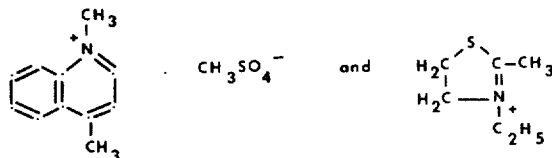
(I)

(II)



(III)

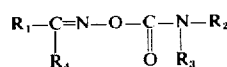
By replacing compound (II) by



respectively blue and yellow methine dyes were obtained.

I claim:

1. In a recording process in which an amine is image-wise released from an amine source carried in effective amount on a support and including the step of image-wise exposing said support to activating radiation, the improvement wherein said amine source is a thermo- or photosensitive amine progenitor corresponding to the following general formula:



in which:

R₁ represents (1) an aliphatic group or a cycloaliphatic group, (2) an aryl group, (3) a heterocyclic group, or (4) an acyl group, and

10 R₂ represents (1) an aliphatic group or a cycloaliphatic group, (2) an aryl group, or (3) a heterocyclic group, and

15 R₃ represents (1) hydrogen, (2) an aliphatic group or a cycloaliphatic group, (3) an aryl group, or (4) a heterocyclic group, or

R₃ and R₂ for together part of a heterocyclic ring, and R₄ represents hydrogen, an aliphatic group, a cycloaliphatic group or an aromatic group.

2. A process according to claim 1, wherein said amine progenitor releases a polyfunctional amine capable of acting as cross-linking agent.

3. A process according to claim 1, wherein said amine progenitor upon exposure releases an aromatic amine capable of taking part in a dye-forming reaction.

25 4. A process according to claim 1, wherein said amine progenitor upon exposure releases a high pH amine.

5. A process according to claim 1, wherein said amine progenitor upon exposure releases an amine capable of catalyzing a dye-forming reaction.

6. A process according to claim 3, wherein the dye-

forming reaction takes place by means of an oxidizing agent incorporated in the recording material.

60 7. A process according to claim 6, wherein the oxidizing agent is m-chloroperbenzoic acid.

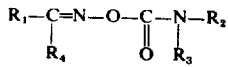
8. A process according to claim 6, wherein a mixture of said amine progenitor, an oxidizing agent and a color coupler reactive with said released amine to form a dye is present on said support.

9. A process according to claim 1, wherein said amine progenitor upon exposure step release a p-

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phenylenediamine derivative, which is capable of producing an indophenol or azamethine dye by oxidative coupling with a phenol, naphthol or active methylene type colour coupler.

10. A recording material comprising a support having thereon a layer of a film forming binding agent containing an effective amount of a photosensitive and/or thermosensitive amine progenitor releasing an amine upon exposure to activating radiation and corresponding to the following general formula:



in which:

R₁ represents (1) an aliphatic group or a cycloaliphatic group, (2) an aryl group, (3) a heterocyclic group, or (4) an acyl group, and

R₂ represents (1) an aliphatic group or a cycloaliphatic group, (2) an aryl group, or (3) a heterocyclic group, and

R₃ represents (1) hydrogen, (2) an aliphatic group or a cycloaliphatic group, (3) an aryl group, or (4) a heterocyclic group, or

R₃ and R₂ form together part of a heterocyclic ring, and

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R₄ represents hydrogen, an aliphatic group, a cycloaliphatic group, or an aromatic group.

11. A recording material according to claim 10, wherein

R₁ represents an alkyl group or a phenyl group,

R₂ represents an alkyl group,

R₃ represents hydrogen or

R₂ and R₃ form together part of a piperidine or morpholine ring and

R₄ represents hydrogen.

12. A recording material according to claim 10, wherein said amine progenitor is present in admixture with a phenol, naphthol and/or active methylene type coupler capable of oxidative coupling with the released amine.

13. A recording material according to claim 10 wherein said progenitor and binding agent are present in a weight ratio of 1:5-1:50.

14. A recording material according to claim 12 wherein said admixture also contains an oxidizing agent.

15. A recording material according to claim 14, wherein the oxidizing agent is m-chloroperbenzoic acid.

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