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(54) **Thermal transfer imaging.**

(57) A method of imaging comprising the following steps :

(a) assembling a donor sheet having a donor layer comprising a thermally transferable colourant, and a receptor sheet so that the donor layer of the donor sheet is in intimate contact with the receptor sheet, one of the donor and receptor sheets comprising a radiation-absorbing material ;

(b) contacting the donor-receptor assembly with a photographic mask, and

(c) exposing the donor-receptor assembly through the photographic mask by means of a scanning exposure source so that in areas defined by the transparent regions of the mask, the exposing radiation is absorbed and converted to thermal energy by the radiation-absorbing material to effect the thermal transfer of colourant from the donor sheet to the receptor sheet.

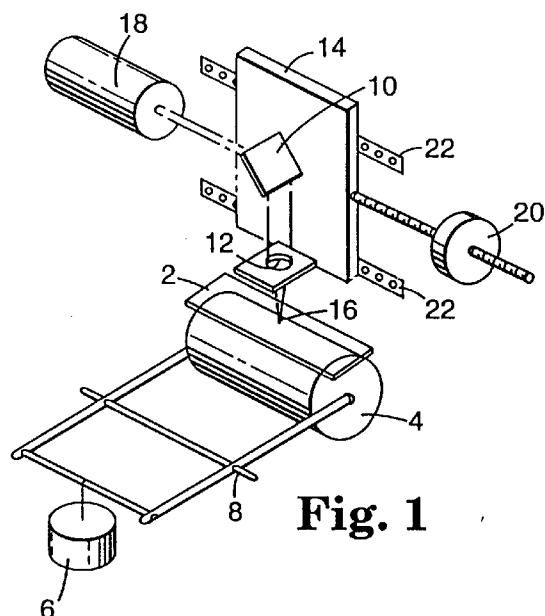


Fig. 1

This invention relates to a method of thermal transfer imaging, in which a mask bearing image information is contacted with an assembly of a donor sheet having a donor layer comprising a thermally transferable colourant, and a receptor sheet for said thermally transferred colourant, and irradiated by a scanning exposure source to effect the imagewise transfer of colourant from the donor sheet to the receptor sheet.

Thermal transfer imaging involves the imagewise-transfer of colourant from a donor sheet to a receptor sheet under the action of heat, the donor and receptor sheets being maintained in intimate, face-to-face contact throughout. This type of imaging is increasingly popular, mainly because it is "dry" (requiring no chemical development) and hence is compatible with the home or office environment.

The heat required to effect the transfer of the colourant is usually supplied by contacting the assembled (but not bonded) donor and receptor sheets with so-called "thermal printheads" comprising arrays of miniature, electrically-heated elements, each of which is capable of being activated in a timed sequence to provide the desired imagewise pattern of heating. However, such systems provide rather poor resolution and increasing interest is being shown in the use of radiant or projected energy, especially infrared radiation, to supply the heat, thereby taking advantage of the greater commercial availability of laser diodes emitting in the near-infrared region. This is achieved by incorporating a radiation-absorber in the donor-receptor assembly and subjecting the same to an imagewise pattern of radiation. When the donor-receptor assembly is irradiated by radiation of an appropriate wavelength, the radiation-absorber converts the incident energy to thermal energy and transfers the heat to colourant in its immediate vicinity, causing imagewise transfer of colourant to the receptor sheet. In certain circumstances, the colourant may itself be radiation-absorbing, such that no additional absorber is required.

Two distinct methods are known in which radiation is used to effect thermal transfer of a colourant. In the first method, a laser is scanned directly over the donor-receptor assembly, while its intensity is modulated in accordance with digitally stored image information. This method is disclosed in, for example: Research Disclosure No. 142223 (February 1976); Japanese Patent No. 51-88016; U.S. Patent No 4973572; British Patent No. 1433025, and British Patent Publication No. 2083726. Although this method provides very good resolution, it has the disadvantage of long imaging times. As the image must be built up point-by-point, scan times of several minutes are required to build up an A4-sized image, even if an array of lasers is used.

The second method involves a flood exposure from a momentary source, such as a xenon flash lamp, through a suitable mask held in contact with the donor-receptor assembly. This method is disclosed in, for example: Research Disclosure No. 142223 (February 1976); U.S. Patent Nos. 3828359, 4123309, 4123578 and 4157412, and European Patent No. 365222.

Provided the mask is of high quality (as would be provided, for example, by a silver halide film, such as a graphic arts film), then this method is also capable of producing high resolution images. It also has the added advantage that the entire image (regardless of size) is produced with a single exposure of a fraction of a second. However, there are several disadvantages associated with this method. Xenon flash lamps tend to be bulky, have high power consumption and pose heat dissipation problems, but more importantly, it is very difficult in practice to obtain large area images of high quality by this method without damaging the mask bearing the image information. This is because, under normal circumstances, the opaque areas of the mask are themselves absorbing and, since the entire area of the mask is illuminated, a large amount of energy is absorbed by the mask with no means by which it can be dissipated quickly. Consequently, high temperatures are generated within the mask, leading to melting or distortion. As the energy absorbed is proportional to the area exposed, the problem becomes more acute with larger-sized images.

The use of a reflective mask, as disclosed in, for example, U.S. Patent No. 3828359, avoids this problem, but such masks are not as readily available as those produced from conventional silver halide films, and they cannot be fabricated with the same degree of accuracy and precision.

The use of a xenon flash exposure generally necessitates the use of carbon black or a similar material as the radiation-absorber, because a xenon lamp is a broad band emitter and a material with a similarly broad absorption is required to make effective use of the available energy. The current trend is to substitute infrared-absorbing dyes for carbon black in pursuit of higher resolution, and also in order to reduce the likelihood of image contamination by the radiation-absorber, e.g., as disclosed in European Patent Publication Nos. 321923, 403930, 403931, 403932, 403933, 403934, 404042, 405219, 405296, 407744, 408891, 408907 and 408908. Since dyes have a relatively narrow absorption band, higher intensity xenon flashes would be required, which compounds the heat-distortion problem described earlier.

Research Disclosure No. 14223 (February 1976) discloses the use of a continuous laser to effect the transfer of colourant from a donor to a receptor, but this is in the situation where either the colourant or the radiation-absorber is already in the required image pattern on the donor sheet and does not involve the use of a contact mask to modulate a scanned continuous laser.

The present invention seeks to provide an alternative method of thermal transfer imaging which does not

suffer from the disadvantages associated with known methods of thermal transfer imaging.

According to the present invention, there is provided a method of imaging comprising the following steps:

(a) assembling a donor sheet having a donor layer comprising a thermally transferable colourant, and a receptor sheet such that the donor layer of the donor sheet is in intimate contact with the receptor sheet,

one of the donor and receptor sheets comprising a radiation-absorbing layer;

(b) contacting the donor-receptor assembly with a photographic mask, and

(c) exposing the donor-receptor assembly through the photographic mask by means of a scanning exposure source so that in areas defined by the transparent regions of the mask, the exposing radiation is absorbed and converted to thermal energy by the radiation-absorbing layer to effect the thermal transfer of colourant from the donor sheet to the receptor sheet.

Any suitable scanning exposure source may be used to effect thermal transfer of the colourant from the donor sheet to the receptor, although a continuous exposure source, such as a laser, is preferred. By suitable adjustment of the various parameters, such as laser power, spot size, scan rate and focus position, it is possible to effect thermal transfer imaging without damaging the photographic mask. This is due to the fact that only a small area of the mask is irradiated at any one instant, with the remainder available to act as a heat sink. The optimum exposure parameters depend on a number of variables, such as the sensitivity of the thermal transfer media and the thermal conductivity of both the mask and the radiation-absorber.

For a given laser spot size, the energy flux per unit area experienced by both the mask and the media is a function of the laser power, the scan rate (dwell time) and focus for a given energy flux. Better colourant transfer is obtained from a relatively short exposure at high power. This enables a high temperature to be generated within the imaging media (which is necessary for colourant transfer) as there is insufficient time for the heat to dissipate laterally. Conversely, from the point of view of damage to the mask, lateral heat dissipation is essential, and so longer exposure at lower power is preferable.

While these are conflicting requirements, we have found that an overlap exists between the exposure conditions compatible with masks derived from commercially available graphic-arts films, and those required to image currently available thermal transfer media. For example, using a laser diode focused to a 20 μ m spot, it is found that exposures of up to 0.7msec at 20mW are tolerated by masks prepared from 3M DRC-S or Fuji KU S100 contact films. Alternatively, at 15mW power, exposures of 20msec or more can be tolerated.

Different contact films produce different responses depending on factors, such as the thermal conductivity of the silver image, the thickness of the emulsion layer etc. As these are not normally under the control of the general user, trial and error will be needed to determine the conditions for optimum exposure of specific combinations of mask and media. Generally, the mask should have a thermal conductivity of at least $2 \times 10^{-3} \text{ W cm}^{-1} \text{ K}^{-1}$.

In principle, the mask may be prepared from any photographic material capable of generating a reflective or absorbing image, e.g., conventional silver halide materials, photothermographic materials, xerographic materials etc., but most commonly the mask is prepared by conventional techniques from a graphic arts film, such as a contact film, a duplicating film, a high-contrast lith film or an imagesetting film. In the situation where the mask is prepared via a laser scanner, the same laser may be used to image the thermal transfer media through the mask, which lends to savings in equipments costs.

In principle, any thermal transfer media which can be addressed by a scanning exposure source may be used in the method of the invention. Such media generally comprise colourant donor and receptor sheets which are assembled in intimate, face-to-face contact prior to imaging. "Colourant" is used in its broadest sense, and covers any material capable of modifying the surface of a receptor, visibly or otherwise (particularly with respect to optical density). Ordinarily, the colourant comprises one or more dyes or pigments with or without a binder. If the transferred image is to be used for colour-proofing purposes, it is highly desirable that the colourant comprises dyes or pigments that reproduce the colours shown by standard printing ink references provided by the International Prepress Proofing Association, known as the SWOP colour references. Examples of such dyes are disclosed in U.S. Patent No. 5024990. Preferably, the thermal transfer media are sufficiently sensitive to effect the transfer of colourant at energy levels of less than 4J/cm².

The donor sheet normally comprises a support bearing a donor layer containing the colourant, either with or without a binder, but may also be a self-supporting film of binder and colourant, e.g., as disclosed in our copending European Patent Application No. 91311759.2, filed 18th December 1991.

The receptor sheet may be of any suitable material, such as paper, plastics films etc., but advantageously comprises a support bearing a receptor layer of a heat-softenable, usually thermoplastic, resin.

A radiation-absorber (ordinarily absorbing radiation in the wavelength region 600 to 1070nm, more usually 750 to 980nm) must be present in one of the donor and receptor sheets, although if the colourant is itself radiation-absorbing (as disclosed, e.g., in our copending International Patent Application No. PCT/GB92/01489 entitled "Thermal Transfer Imaging", no additional absorber may be necessary.

The radiation-absorbing material may comprise any suitable material able to absorb the radiant energy, convert it to heat energy and transfer that heat energy to the colourant. Examples of suitable radiation-absorbers include pigments, such as carbon black, e.g., as disclosed in British Patent No. 2083726, and infrared-absorbing dyes, including: phthalocyanine dyes, e.g., as disclosed in U.S. Patent No. 4547444; ferrous complexes, e.g., as disclosed in U.S. Patent No. 4912083, squarylium dyes, e.g., as disclosed in U.S. Patent No. 4942141; chalcogenopyrrolo-arylidene dyes, e.g., as disclosed in U.S. Patent No. 4948776; bis(chalcogenopyrrolo)polymethine dyes, e.g., as disclosed in U.S. Patent No. 4948777; oxyindolizine dyes, e.g., as disclosed in U.S. Patent No. 4948778; tetraarylpolymethine dyes; bis(aminoaryl)polymethine dyes, e.g., as disclosed in U.S. Patent No. 4950639; merocyanine dyes, e.g., as disclosed in U.S. Patent No. 4950640; dyes derived from anthraquinones and naphthoquinones, e.g., as disclosed in U.S. Patent 4952552; cyanine dyes, e.g., as disclosed in U.S. Patent No. 4973572; trinuclear cyanine dyes, e.g., as disclosed in European Patent Publication No. 403933; oxonol dyes, e.g., as disclosed in European Patent Publication No. 403934; indene-bridged polymethine dyes, e.g., as disclosed in European Patent Publication No. 407744; nickel-dithiolene dye complexes, e.g., as disclosed in European Patent Publication No. 408908, and croconium dyes, e.g., as disclosed in our copending British Patent Application No. 9209047.1, filed 27th April, 1992.

The radiation-absorber may be present in the same layer as the colourant (as disclosed in, e.g., European Patent Publication No. 403933) or it may be present in a separate layer on the donor (as disclosed in, e.g., Japanese Patent No. 63-319191), but for many purposes it is preferable for the radiation-absorber to be situated in the receptor, e.g., in a layer between the support and receiving layer, or in the receptor layer itself, as disclosed in PCT/GB/9201489. The inclusion of the radiation-absorber in either the receptor layer or, more preferably, in an ordinarily adjacent underlayer thereto, is found to offer significant advantages over conventional thermal transfer materials in terms of both higher resolution and greater sensitivity since the heating effect is induced directly in the receptor.

Donor materials suitable for use with this embodiment of the invention are described in PCT/GB/9201489 and include substrates coated with either a layer of vapour-deposited dye or pigment (preferably along with a controlled release layer as disclosed in U.S. Patent Application Serial Nos. 07/775782 and 07/776602) or a thin layer (<1µm) of a binder containing a high concentration of one or more dyes.

In embodiments where the radiation-absorber is present in the donor sheet, the donor sheet may be of the dye-diffusion (sublimation) type, whereby colourant dyes or pigments are transferred to the receptor in an amount proportional to the intensity of radiation absorbed, but it is preferably of the mass-transfer type, whereby essentially either 0% (zero) or 100% transfer of colourant takes place, depending on whether the absorbed energy in a given area reaches a threshold value. Such materials are well-suited to half-tone imaging, and have several advantages, such as the provision of matched positive and negative images (on the donor and receptor respectively), saturated colours, and the ability to image large areas with a uniform optical density. In mass-transfer donor materials, the colourant frequently comprises one or more dyes or pigments in a waxy binder, the entire mixture being transferable.

PCT/GB/9201489 also discloses another type of mass transfer media in which the donor layer comprises a vapor-deposited colourant with no binder present. Such materials comprise a radiation-absorbing layer, ordinarily coated on a support sheet, over which is coated the vapor-deposited colourant layer, although where the colourant is itself radiation-absorbing, a separate radiation-absorbing layer may be unnecessary.

The use of a vapor-deposited colourant offers significant advantages over conventional materials, in which the colourant is dissolved or dispersed in a binder, both in terms of higher resolution and greater sensitivity (speed). A vapor-deposited colourant is also free from contamination by binder materials and produces a pure, more intense image on the receptor. Also the transferred image shows a highly uniform optical density, even when large areas are transferred.

The colourant may be selected from a wide range of dyes and pigments, both organic and inorganic, that are capable of being vapour-deposited. Suitable inorganic pigments include metals, e.g., aluminium, copper, gold and silver, and metal oxides. The inorganic pigment may advantageously comprise a graded mixture of metal and metal oxide, formed as described in U.S. Patent Nos 4364995 and 4430366, e.g., "black aluminium oxide" which is a graded mixture of aluminium and aluminium oxide formed by vapor-depositing aluminium in the presence of controlled amounts of oxygen. Suitable organic materials include indoanilines, amino-styryls, tricyanostyryls, methines, anthraquinones, phthalocyanines, indamines, triarylmethanes, benzylidenes, azos, monoazones, xanthenes, indigoids, oxonols, naphthols and pyrazolones. Any of the known techniques of vapour deposition may be used. Preferably, the colourant layer has a columnar microstructure, as disclosed in U.S. Patent Application Serial No. 07/775782.

Other types of mass-transfer media suitable for use in the invention include the ablation transfer media described in WO90/12342 and WO92/06410 and the peel-apart media disclosed in WO93/03928.

Several different kinds of laser may be used to effect the thermal transfer of colourant from the donor to

the receptor sheet, including gas ion lasers, such as argon and krypton lasers; metal vapor lasers, such as copper, gold and cadmium lasers, and solid state lasers, such as ruby or YAG lasers but in practice, diode lasers, such as gallium arsenide lasers, which offer substantial advantages in terms of their small size, low cost, stability, reliability, ruggedness and ease of modulation in accordance with digitally stored information, are preferred. Lasers emitting radiation in the infrared region from 750 to 980nm are preferred, although lasers emitting outside of this region may be usefully employed in the practice of the present invention.

The laser preferably has an emission power of at least 5mW, with the upper power limit depending on the characteristics of the mask and the media, as well as the scan speed and spot size. The laser is focused on the radiation-absorbing layer to give an illuminated spot of small, but finite dimensions, e.g., a circle of 20 μ m diameter, which is scanned over the entire area of the mask and media. The laser output may be adjusted via a cylindrical lens to a narrow line, e.g., 1cm x 20 μ m, the longer dimension of which is perpendicular to the direction of scan. This permits a larger area to be scanned in one pass, although higher power and/or longer dwell times will be necessary to compensate for the larger area over which the energy is dissipated. Scanning of the laser may be carried out by any of the known methods, but will normally involve raster scanning, with successive scans abutting or overlapping as desired. Two or more lasers may scan different areas of a large image simultaneously.

To ensure good resolution and effective image transfer, it is essential that the donor, receptor and mask are held in intimate contact with each other during imaging. This is frequently achieved by subjecting the assembly of mask and donor and receptor sheets to pressure, ordinarily at least 10g/mm², preferably at least 40g/mm² for media of the type disclosed in PCT/GB/9201489. Other types of media do not generally require such high pressures, and vacuum hold-down is sufficient.

Multicolour images may be produced by repeating the above described imaging methods with successive donor sheets of different colours using the same receptor in each case.

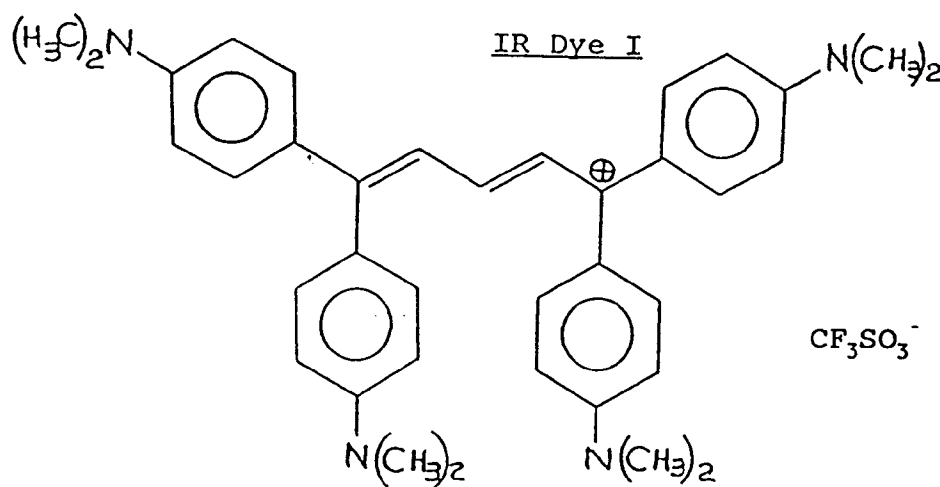
After the desired image has been formed on the receptor, it may optionally be transferred to a different substrate, e.g., plain paper stock, by a suitable thermal lamination process, as disclosed, for example, in European Patent Publication No. 454083.

The present invention will now be described with reference to the accompanying non-limiting Example in which the following donor and receptor sheets were prepared for use therein.

Donor Element A*

Support: poly(ethylene terephthalate) polyester base (100 μ m thick).

IR-absorbing layer: IR-Dye I(0.05g) was added to bisphenol-A-polycarbonate (3.33g; commercially available from Polysciences Inc.) in dichloromethane (26.6g) and cyclohexanone (3.33g). The resulting mixture was stirred for 30 minutes and then knife-coated at 37.5 μ m wet thickness onto the support. The coating was dried at 30°C for 2 hours.



Donor layer: a copper phthalocyanine pigment, commercially available from Sun Chemicals Inc., was purified by vacuum sublimation at 500°C and 200Nm⁻² (1.5 Torr) (argon) pressure. The purified pigment was loaded

* Donor Element A and Receptor Element B are in accordance with PCT/GB/9201489.

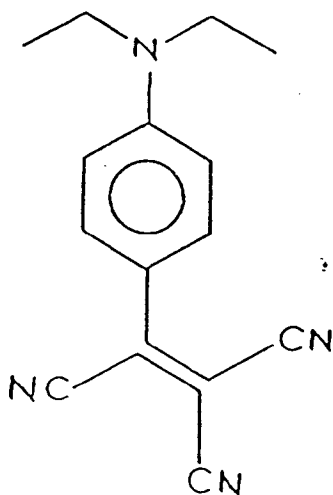
in a heater made from stainless steel sheet material and the heater positioned in a custom built 30cm bell jar vacuum coater equipped with a diffusion pump and a 15cm web drive, about 4cm below the web. The support (with IR-absorbing layer) was fed onto the web drive before pumping the vacuum chamber down to $6.7 \times 10^{-3} \text{ Nm}^{-2}$ (5×10^{-5} Torr) pressure. The heater was heated to 410°C using an applied a.c. power supply to vaporise and deposit the pigment onto the IR-absorbing layer, the web drive moving at a speed of 0.25cm per second.

Donor Element B

Support: poly(ethylene terephthalate) polyester base (100 μm thick).

Donor layer: Magenta Dye I (0.8g) and a dispersant (0.3g; commercially available from Troy Chemicals under the trade name CDI) were added to a solution of CAB 381-20 (cellulose acetate butyrate) (0.8g; commercially available from Eastman Kodak) in methyl ethyl ketone (30g) and methanol (20g). The resulting mixture was coated onto the support at Kbar 0 (4 μm wet thickness) to produce a magenta coating having a transmission optical density of 0.6 absorbance units at 530nm. "Kbars" are wire wound coating rods commercially available from R.K. Printcoat Instruments Ltd.

Magenta Dye I



Donor Element C

Support: poly(ethylene terephthalate) polyester base (75 μm thick).

IR-absorbing/Donor layer: a boehmite (A10.0H) subbing layer (0.4% by weight; 10 μm wet thickness; commercially available from Vista Chemical Co. under the trade name CATAPAL D) was coated onto the support, dried at 80°C and overcoated with a vapor-deposited layer of "black aluminium oxide" approximately 0.15 μm thick, following the procedure disclosed in U.S. Patent Nos. 4364995 and 4430366. The transmission optical density of the layer was determined to be at least 4.6 absorbance units.

Receptor Element A

Support: paper base.

Receptor layer: a layer (1.5 μm thick) of poly(ethylene-acrylic acid) emulsion ($T_g=34^\circ\text{C}$; commercially available from Schering), was coated on the support.

Receptor Element B *

Support: poly(ethylene terephthalate) polyester base (100 μm thick).

IR-absorbing layer: a mixture of IR-Dye I (0.05g) and bisphenol-A-polycarbonate (6.7g) in dichloromethane (53.2g) and cyclohexanone (6.7g) was coated at 25 μm wet thickness onto the support.

Receptor layer: a poly(vinylidene chloride-vinyl acetate) resin (1.5g; $T_g=79^\circ\text{C}$; commercially available from Union Carbide under the trade name VINYLITE VYNS), in a mixture (10g) of methyl ketone and toluene (1:1)

was coated at Kbar 1.

Example

The following experiment was performed to investigate the effect of varying the energy supplied to the mask during imaging.

A series of half-tone images were produced on the following commercially available contact films: DRC4-S and DRC4-P commercially available from Minnesota Mining & Manufacturing Co; KU-8100 commercially available from Fuji, and CCC100E commercially available from Konica, using an UGRA test wedge. Each half-tone mask was placed around the support roller of the scanner assembly shown in Figure 1 and described hereinafter.

Referring to Figure 1, the support roller (2) is biased against a transparent pressure plate (4) by a suitable weight (6) acting through pivot (8). A mirror (10) and focusing lens (12) mounted on a support (14) are provided to focus the beam (16) from a laser diode (18) at the imaging plane (not shown), that is, onto the mask at the point of maximum pressure provided by the roller (2). A linear stepped motor drive (20) advances the support (14) along slides (22). A pressure of 40g/mm² was applied between the pressure plate (2) and support roller (4) and a series of scans at various laser powers and scan rates were performed. The laser diode, emitting at 820nm, was focused to a spot size of 20μm.

The energy applied to each mask was calculated by:
$$\text{Energy Applied} = \frac{\text{Laser Power}}{\text{Scan Rate} \times \text{Spot Diameter}}$$
 TABLES 1 to 4 below show the marking results versus the energy applied for each film



One or more films not marked.



All films marked.

TABLE 1

Laser marking on contact films at 20mW laser power

Scan Rate (cm/s)	Energy Applied (J/cm ²)	Film Marking
5	2	
4	2.5	
3	3.3	
2	5	
1	10	
0.1	100	

TABLE 2

Laser marking on contact films at 15mW laser power

Scan Rate (cm/s)	Energy Applied (J/cm ²)	Film Marking
5	1.5	
4	1.9	
3	2.5	
2	3.75	
1	7.5	
0.1	75	

TABLE 3

Laser marking on contact films at 10mW laser power

Scan Rate (cm/s)	Energy Applied (J/cm ²)	Film Marking
5	1	
4	1.25	
3	1.67	
2	2.5	
1	5	
0.1	50	

TABLE 4

Laser marking on contact films at 5mW laser power

Scan Rate (cm/s)	Energy Applied (J/cm ²)	Film Marking
5	0.5	
4	0.6	
3	0.8	
2	2.25	
1	2.5	
0.1	25	

The results show that all masks are marked at energies of approximately 4J/cm² at 15mW laser power. Consequently, the chosen media should be sufficiently sensitive to allow for the transfer of colourant at energies less than this value.

The above experiment was repeated using the following donor-receptor assemblies:

- (a) Donor A: Receptor A;
- (b) Donor B: Receptor B, and
- (c) Donor C: Receptor A,

in order to investigate how colourant transfer varies with energy applied. The laser diode was focused onto

the IR-absorbing layer of the donor or receptor sheet at the point of maximum pressure provided by the support roller of the imaging assembly. A pressure of 100g/mm² was applied between the pressure plate and support roller.

The Energy applied to each composite was calculated by:

$$\text{Energy Applied} = \frac{\text{Laser Power}}{\text{Scan Rate} \times \text{Spot Diameter}}$$

The results obtained are shown in TABLES 5 to 8 below.

TABLE 5

Colourant transfer between donor and receptor elements at 20mW laser power.

Scan Rate (cm/sec)	Energy Applied (J/cm ²)	Dye Transfer*		
		Donor A	Donor B	Donor C
5	2	x	x	x
4	2.5	x	x	x
3	3.3	x	x	x
2	5	x	x	x
1	10	x	x	x
0.1	100	x	x	x

* x = transfer of colourant to receptor

TABLE 6

Colourant transfer between donor and receptor elements at 15mW laser power.

Scan Rate (cm/sec)	Energy Applied (J/cm ²)	Dye Transfer*		
		Donor A	Donor B	Donor C
5	1.5	x	x	x
4	1.9	x	x	x
3	2.5	x	x	x
2	3.75	x	x	x
1	7.5	x	x	x
0.1	75	x	x	x

* x = transfer of colourant to receptor

TABLE 7

Colourant transfer between donor and receptor elements at 10mW laser power.

Scan Rate (cm/sec)	Energy Applied (J/cm ²)	Dye Transfer*		
		Donor A	Donor B	Donor C
5	1	-	-	x
4	1.25	-	-	x
3	1.67	-	-	x
2	2.5	x	x	x
1	5	x	x	x
0.1	50	x	x	x

* x = transfer of colourant to receptor
- = no transfer of colourant

TABLE 8

Colourant transfer between donor and receptor elements at 5mW laser power.

Scan Rate (cm/sec)	Energy Applied (J/cm ²)	Dye Transfer*		
		Donor A	Donor B	Donor C
5	0.5	-	-	-
4	0.6	-	-	-
3	0.8	-	-	-
2	2.25	-	-	-
1	2.5	-	-	-
0.1	25	-	-	x

* x = transfer of colourant to receptor
- = no transfer of colourant

By comparing TABLES 1 to 4 with TABLES 5 to 8, it can be seen that for a scanning spot of 20µm size, there exists a 'window' enabling contact exposure without mask destruction where the Threshold Energy (E) is <4J/cm² and the laser power is <15mW. This window is more clearly illustrated by Figure 2 of the accompanying drawings which represents a plot of Threshold Energy (E) vs. laser power at the imaging plane, thereby allowing a direct comparison of mask sensitivity with that of the assembled donor and receptor sheets. Accordingly, donor media should be selected having an appropriate sensitivity for use with the imaging parameters indicated by this window. With a larger spot size, the Threshold Energy (E) would be expected to be smaller, requiring more sensitive donor media. "VINYLLITE VYNS" (Union Carbide), "CATAPAL D" (Vista Chemical Co.) "DRC4-S" and "DRC4-P" (Minnesota Mining and Manufacturing Co.), "CA-2000" (Kodak Ltd.), "KU-8100 (Fuji) and "CCC100E" (Konica) are all trade name/designations.

Claims

1. A method of imaging comprising the following steps:
 - (a) assembling a donor sheet having a donor layer comprising a thermally transferable colourant, and a receptor sheet so that the donor layer of the donor sheet is in intimate contact with the receptor sheet, one of the donor and receptor sheets comprising a radiation-absorbing material;
 - (b) contacting the donor-receptor assembly with a photographic mask, and
 - (c) exposing the donor-receptor assembly through the photographic mask by means of a scanning exposure source so that in areas defined by the transparent regions of the mask, the exposing radiation is absorbed and converted to thermal energy by the radiation-absorbing material to effect the thermal transfer of colourant from the donor sheet to the receptor sheet.
2. A method as claimed in Claim 1 in which the photographic mask has a thermal conductivity of at least $2 \times 10^{-3} \text{ W cm}^{-1} \text{ K}^{-1}$.
3. A method as claimed in Claim 1 or Claim 2 in which the assembled donor and receptor sheets form a system which is sufficiently sensitive to effect transfer of colourant at energy levels of less than 4 J/cm^2 .
4. A method as claimed in any one of Claim 1 to 3 in which the donor sheet is a mass-transfer material.
5. A method as claimed in any preceding Claim in which the donor sheet comprises a support bearing a donor layer comprising the colourant.
6. A method as claimed in Claims in which the donor sheet comprises a support having coated thereon a radiation-absorbing layer comprising the radiation-absorbing material overcoated with a layer of a vapor-deposited colourant
7. A method as claimed in any preceding Claim in which the receptor sheet comprises a support having coated thereon a layer of a heat-softenable resin.
8. A method as claimed in any one of Claims 1 to 4 in which the receptor sheet comprises a support having coated thereon a receptor layer, the receptor sheet further comprising, in either the receptor layer or an underlayer thereto, the radiation-absorbing material.
9. A method as claimed in any preceding Claim in which the radiation-absorbing material absorbs radiation having a wavelength of from 600 to 1070nm.
10. A method as claimed in any preceding Claim in which said exposure source is a continuous, scanning exposure source.
11. A method as claimed in any preceding Claim in which the exposure source is a laser.
12. A method as claimed in Claim 10 in which the laser is a laser diode.
13. A method as claimed in Claim 10 or Claim 14 in which the laser has a power of at least 5mW.
14. A method as claimed in any preceding Claim in which a pressure of at least 10 g/mm^2 is applied to the donor-receptor assembly.
15. A method as claimed in any preceding Claim in which the mask is derived from a silver halide photographic film.

