

INFORMATION RECORDING METHOD

Technical Field

The present invention relates to the recording of information in an intermediate layer of a laminated structure, the intermediate layer being capable of absorbing incident laser radiation.

Background of the Invention

A wide variety of items now have applied to them tags, stickers and cards for the purposes of identifying the item and/or providing information in respect thereof. For example, bar codes and other images are used for identification purposes and for conveying information in respect of the item to which they are attached.

When the recorded information is exposed it is prone to be damaged and/or tampered with.

It is known to use a laser beam to record information, such as the method described in United States Patent No. 3,787,210. This particular previous method does not record information in an arrangement in which the information is not vulnerable.

Object of the Invention

It is the object of the present invention to overcome or substantially ameliorate the above disadvantages.

Summary of the Invention

There is disclosed herein a method of recording information, said method including the steps of:

providing a laminating structure which includes an intermediate layer located between a transparent layer and a non-absorbing layer, the intermediate layer being substantially absorptive of laser radiation having a predetermined wavelength, the transparent layers being substantially transparent with respect to said laser radiation while the non-absorbing layer is substantially non-absorptive of said laser radiation;

directing a pulsed beam of said laser radiation at said laminated structure so as to have the beam pass through said transparent layer to be absorbed by areas of said intermediate layer to ablate said areas;

providing relative movement between said pulsed laser beam and said laminated structure to produce a predetermined pattern of said areas.

Preferably said intermediate layer is a metallised layer which is ablated (i.e. vaporised) by said laser beam. Preferably said intermediate layer will be a thin layer of Aluminium and said laser radiation will have a wavelength at or near 1.064 micrometers. In one preferred embodiment said laminated structure includes a contrast

layer which is non-absorbing of said laser radiation and which provides a visible contrast between regions of said intermediate layer which have been modified by said laser beam and regions which have not.

Preferably, the beam has a wavelength of 0.96 to 1.16 micrometers.

5 Preferably, the beam has a pulse repetition rate of 10 to 100 kHz.

Preferably, the beam has a pulse duration rate of 0.1 to 50 microseconds.

Preferably, the non-absorbing layer is transparent or reflective.

In a still further preferred form, the intermediate layer has a thickness of 1 to 100 nanometres.

10 There is further disclosed herein a laminated structure including an intermediate layer located between a transparent layer and a non-absorbing layer, the intermediate layer being substantially absorptive of laser radiation having a pre-determined wavelength, the transparent layer being substantially transparent with respect to said laser radiation while the non-absorbing layer is substantially non-absorbing of said laser radiation; and wherein

15 said intermediate layer has areas that are ablated so that the laminated structure contains information.

Description of Preferred Embodiments

Preferred embodiments of the present invention will now be described by way of non-limiting example with reference to the accompanying drawings, wherein:

Figure 1 is a schematic illustration of the laser writing apparatus of the present invention;

Figure 2 is a schematic illustration of cross sectional views of two preferred embodiments of label material as used in the present invention;

25 Figure 3 is a schematic illustration of a cross sectional view of hot stamping foil material.

Figure 1 is a schematic illustration of one preferred embodiment of the present method for recording information in self adhesive label material. In Figure 1 a Nd:YAG laser light source 001 operating at an optical wavelength of approximately 1.064 micrometers generates a beam of focused laser light 002. The beam of laser light 002 is directed to the label material 003 so as to record information in an internal layer within the label material 003. A mirror apparatus 004 controls the pointing direction of the beam 002 and therefore the position of the beam 002 at the label material 003. The steering orientation of the mirror apparatus 004 is controlled by a computer 005.

35 Figure 2 shows in cross sectional view schematic illustrations of the essential features of two preferred constructions for the label material 003 of Figure 1.

In Figure 2(a) the label material 003 comprises:

(i) a top layer 006 which is substantially transparent at and near the optical wavelength of 1.064 microns,

(ii) an absorbing layer 007 which is substantially absorptive at and near the optical wavelength of 1.064 microns,

5 (iii) an adhesive layer 008 which is substantially transparent or non-absorbing at and near the optical wavelength of 1.064 microns.

In Figure 2(b) the label material 003 comprises:

(i) a top layer 009 which is substantially transparent at and near the optical wavelength of 1.064 microns,

10 (ii) an absorbing layer 010 which is substantially absorptive at and near the optical wavelength of 1.064 microns,

(iii) a contrast layer 011 which is substantially transparent at and near the optical wavelength of 1.064 microns but which is visibly coloured with a colour which provides reflectivity at the reading wavelengths of standard bar code scanners, and

15 (iv) an adhesive layer 012 which is substantially transparent or non-absorbing at and near the optical wavelength of 1.064 microns.

Preferably the top layers 006 and 009 will be transparent at visible wavelengths. The top layers 006 and 009 may in some embodiments be a polyester layer with a typical thickness in the range 25 to 100 microns.

20 The absorbing layers 007 and 010 will preferably be a thin metallised layer such as a thin layer of Aluminium. The thickness of the absorbing layer will typically be around 5 nanometres but may be between 0.1 and 100 nanometres.

The contrast layer 011 is included to improve visibility of any information recorded in the label material 003 and in particular to improve reading reliability of bar codes and two dimensional bar codes. The contrast layer may in one embodiment be a layer of an ink or similar coating containing a white pigment.

The adhesive layer 008 and 012 will typically have a thickness in the range 15 to 75 micrometers.

30 In the preferred embodiments of Figures 2(a) and 2(b) it should be appreciated that other internal layers may also be included. Any such additional internal layers will preferably be substantially transparent (non-absorbing) at and near an optical wavelength of 1.064 micrometers.

One example of an additional internal layer is an embossing layer, which may be included adjacent to the metallised layer 007 to 010 to allow optical structures (such as optically diffractive structures) to be embossed into the label material 003. Such embossing layers will typically have a thickness of 1 to 2 microns.

Another example of an additional internal layer is a lacquer or varnish layer which may be included to provide tamper indication when the label material 003 has been applied to a substrate and subsequently removed.

The laser light source 001 will preferably be a Nd:YAG laser light source producing a focused beam 002 of laser light at a wavelength of 1.064 microns. The laser light beam 002 is directed through the label material 003 approximately perpendicular to the plane of the label material 003. At the point where the beam passes through the absorbing layer 007 or 010 the beam will typically have a diameter of between 20 to 300 microns. The beam diameter at this point is adjustable by means of adjustment of a lens on the output of the laser light source 001.

The laser light source 001 will preferably be configured to produce a pulsed output laser light beam 002. Pulsing of the laser light beam 002 is necessary in order to avoid localised heating of the label material 003 around the region of exposure of the absorbing layer 007 or 010 to the laser beam 002. Localised heating of the label material can lead to visible damage of the material around the exposed areas, which degrades the quality of the patterns recorded in the label material 003.

The energy in each laser light pulse is adjusted such that as the laser light 002 passes through the label material 003 the absorbing layer 007 or 010 absorbs sufficient energy in the region of incidence of the laser light that the absorbing material in that region is ablated - i.e. vaporised - while the remaining layers of the label material 003 are relatively undamaged by the laser light. The ablated material, which is trapped between the top coat 006 or 009 and adhesive layer 008 or 012, re-condenses as micro-particles which are too small to be seen with the naked eye. Hence the absorbing layer 007 to 010 appears transparent in the regions which have been exposed to the laser light beam 002. An area of the label material 003 which has been exposed to the laser beam 002 therefore takes on the colour of either the contrast layer 011 (if one is present), or the adhesive layer 008 or 012, or (if the adhesive is transparent) any substrate to which the label material 003 is applied.

Typical parameters for the output of the laser light source 001 are as follows:
output wavelength - 1.064 micrometres;
pulse duration - between 1 and 10 microseconds; and
pulse repetition rate - around 50 kHz. It should be appreciated that these laser parameters are indicative only and may be varied.

The stream of laser light pulses in the light beam 002 is directed so as to produce a pattern in the absorbing layer of the label material 003. Steering of the light beam 002 is preferably achieved by controlling the orientation of a steering mirror apparatus 004 in the path of the light beam 002. The scanning speed of the laser beam 002 across

the label material 003 is adjusted in coordination with the repetition rate of the laser light pulses such that continuous lines can be recorded in the label material 003.

The mirror apparatus 004 is controlled by a computer 005. The pattern recorded in the label material 003 is therefore specified by a set of computer instructions. The computer instructions may originate from any of the following:

- bar code or two dimensional bar code pattern generation software;
- computer graphics or image files such as "TIFF" files; and
- computer text files.

The present method thereby enables the recording of alphanumeric, bar codes, 2 dimensional bar codes and other two dimensional data patterns, graphics and images within the label material 003.

The contrast layer 011 is included in the preferred embodiment of Figure 2(b) in order that the pattern recorded in the absorbing layer 010 will be readily visible regardless of the substrate onto which the label material 003 is applied. Normally the adhesive layer 012 will be substantially transparent and so without the contrast layer 011 any pattern recorded in the label material 003 will show as the colour of the substrate onto which the label material 003 is applied. In some circumstances this can make viewing of the recorded patterns difficult and reading of bar codes and 2 dimensional bar codes recorded in the label material 003 unreliable. Inclusion of the contrast layer 011 ensures that any pattern recorded in the label material using the present method will have the colour of the contrast layer, thereby ensuring better visibility and reliable machine reading of bar codes, 2 dimensional bar codes, or other machine readable patterns.

In order to ensure reliable reading using standard readers or scanners, bar codes and two dimensional bar codes are recorded in negative form. In other words, "white" features in a conventional bar code or two dimensional bar code pattern are represented by laser marked regions in the label material 003 while "black" features are not laser marked. A bar code or two dimensional bar code scanner recognises the reflective non laser marked surface in the label material 003 as "black" at almost all reading directions.

It should be noted that the laser light source 001 is typically capable of producing a very tightly focused laser light beam 002. For example, it is possible to produce a spot size at the absorbing layer 007 or 010 of around 20 microns in diameter, which is too small to be readily seen with the naked eye. This also enables the recording of lines with a thickness of around 20 microns.

The laser light beam 002 may in some circumstances be deliverably de-focused at the plane of the absorbing layer 007 or 010 so as to produce a larger spot and therefore a visible line on a single pass of the laser beam 002. Alternatively a line of visible

thickness may be produced by several passes of a more tightly focused laser light beam, but this is more time consuming and therefore less desirable.

An advantage of being able to record very small features in the label material 003 by using a tightly focused laser light beam 002 is that it allows information to be recorded on a very small scale. For example, very small alphanumerics can be recorded, or alternatively very small bar codes or two dimensional bar codes. The present technique allows the recording of smaller features than does conventional printing, which is limited by either the resolution of the ink transfer process or the retention resolution of the paper or other substrate.

Variations on the Preferred Embodiments

It should be appreciated that variations are possible on the preferred embodiments described above.

In one variation the above internal laser marking method is applied to so-called hot stamping foil. Figure 3 is a schematic cross sectional illustration of a typical structure of a hot stamping foil 013, including:

- (i) a carrier layer 014, typically a thin polyester layer (thickness typically of order 10 to 20 micrometers)
- (ii) a release coat 015 (thickness typically of order 1 micrometer)
- (iii) a metallised layer 016, preferably a layer of Aluminium (thickness typically of order 1 to 10 nanometres)
- (iv) a "size" layer 017 which is a layer of heat activated adhesive (thickness typically of order 1 to 5 micrometers).

In some embodiments the hot stamping foil 013 will include an additional embossing layer adjacent to the metallised layer 016. Such an embossing layer allows the embossing of optical structures (such as optically diffractive structures) into the hot stamping foil.

After application of the hot stamping foil to a substrate the polyester carrier 014 is usually removed to leave the release coat 015 exposed.

The above described laser marking method applies to the hot stamping foil 013 in a manner similar to that described in relation to Figures 1 and 2 above. All layers of the hot stamping foil except the metallised layer 016 are substantially transparent or non-absorbing at the wavelength of the laser beam 002 (i.e. at an optical wavelength of around 1.064 micrometres), while the metallised layer 016 is substantially absorbing at this wavelength. Hence the metallised layer is ablated in the regions of exposure to the laser beam 002, leaving the "size" layer visible in such regions. In some preferred embodiments the size layer will be visibly coloured. The above described method of

laser marking may be carried out with the hot stamping foil 013 either before or after the foil 013 is applied to a substrate.

In some embodiments the hot stamping foil 013 will include an additional contrast layer between the metallised layer 016 and size layer 017 in order to provide visible contrast between areas of the metallised layer 016 which have been laser marked and areas which have not been laser marked (in an analogous manner to the contrast layer 011 described above in relation to Figure 2(b)).

Another variation is in relation to the formulation of the label material 003. In one preferred embodiment the top coat 006 or 009 of Figure 2 may be transparent at an optical wavelength of 1.064 microns but opaque at visible wavelengths. In this embodiment a pattern such as a bar code or two dimensional bar code can be recorded in the absorbing layer 007 or 010 of the label material 003 but this pattern will not be visible to the naked eye. The recorded pattern may then be read via existing methods but using readers which have a light source with a wavelength at which the top coat is substantially transparent (such as a wavelength of 1.064 microns). In this embodiment the contrast layer 011 (if included) will preferably be reflective at the said reader wavelength.

In another variation the laser light source 001 may be a laser diode light source operating at or near the optical wavelength of 1.064 micrometers

It should be appreciated that the writing of patterns in the label material 003 using the laser beam 002 may be carried out from either the top side or underside of the material 003.

It should be appreciated that the absorbing layer 007 or 010 need not be a metallised layer, but could be a layer of any material which is visibly and irreversibly damaged or modified by exposure to the laser beam 002.

The claims defining the invention are as follows:

1. A method of recording information, said method including the steps of:
providing a laminating structure which includes an intermediate layer located between a transparent layer and a non-absorbing layer, the intermediate layer being substantially absorptive of laser radiation having a predetermined wavelength, the transparent layers being substantially transparent with respect to said laser radiation while the non-absorbing layer is substantially non-absorptive of said laser radiation;
directing a pulsed beam of said laser radiation at said laminated structure so as to have the beam pass through said transparent layer to be absorbed by areas of said intermediate layer to ablate said areas;
providing relative movement between said pulsed laser beam and said laminated structure to produce a predetermined pattern of said areas.
2. The method of claim 1 wherein the beam has a wavelength of 0.96 to 1.16 micrometers.
3. The method of claim 2 wherein the beam has a wavelength of about 1.064 micrometers.
4. The method of claim 1, 2 or 3 wherein the beam has a pulse repetition rate of 10 to 100 kHz.
5. The method of claim 4 wherein the beam has a pulse repetition rate of 50 kHz.
6. The method of any one of claims 1 to 5 wherein the pulse has a pulse duration rate of 0.1 to 50 microseconds.
7. The method of any one of claims 1 to 6 wherein the non-absorbing layer is substantially transparent with respect to said radiation.
8. The method of any one of claims 1 to 6, wherein the non-absorbing layer is reflective with respect to said laser radiation.
9. The method of any one of claims 1 to 6 wherein said non-absorbing layer is coloured so as to provide a contrast relative to said intermediate layer.
10. The method of any one of claims 1 to 9 wherein the intermediate layer is a lacquer or varnish.
11. The method of any one of claims 1 to 10 wherein the intermediate layer is metallised.
12. The method of claim 10 wherein the intermediate layer includes aluminium.
13. The method of claim 11 or 12 wherein the intermediate layer has a thickness of 1 to 100 nanometres.
14. The method of claim 13 wherein the intermediate layer has a thickness of 10 nanometres.



15. The method of any one of claims 1 to 13 wherein said non-absorbing layer is transparent or reflective.

16. A laminated structure, manufactured according to the method of any one of claims 1 to 15.

5 17. A laminated structure including an intermediate layer located between a transparent layer and a non-absorbing layer, the intermediate layer being substantially absorptive of laser radiation having a pre-determined wavelength, the transparent layer being substantially transparent with respect to said laser radiation while the non-absorbing layer is substantially non-absorbing of said laser radiation; and wherein

10 said intermediate layer has areas that are ablated so that the laminated structure contains information.

