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(54) **Data carrier and a method for manufacturing a data carrier**

(57) A data carrier is disclosed comprising one or more elements comprising symbols, text, graphics or combinations thereof arranged on a surface, wherein the elements are arranged on the surface as microscopic surface irregularities including protrusions, recesses or protrusions and re-cesses as compared to other parts of the element, said recesses or protrusions have a different recess depth or protrusion height respectively in at least one first element (1) as compared to a corresponding background element (B1), wherein the at least one first element is visible to a viewer only at predetermined angles of light reflection, wherein the at least one first element and the corresponding back-ground element are arranged on the surface as an array of pixels.

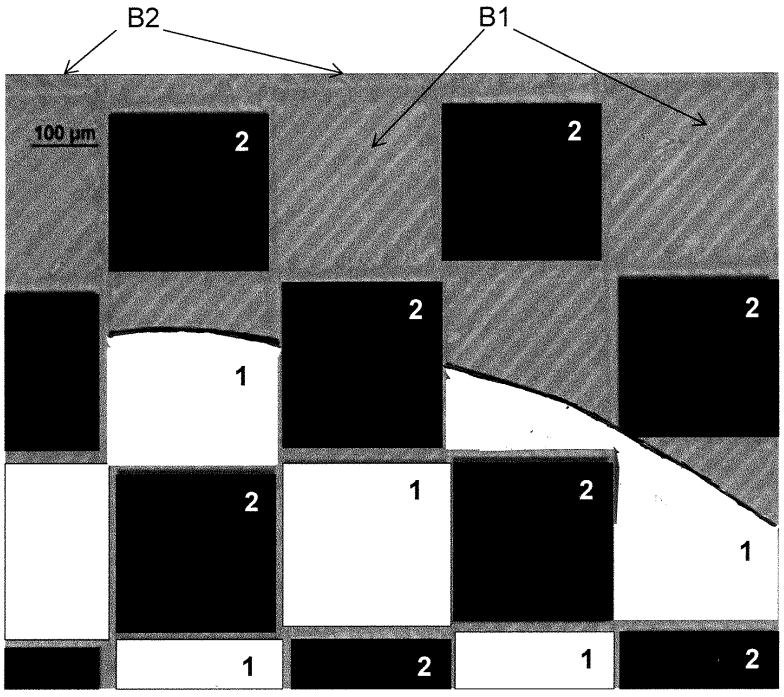

Fig. 3b

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Description

FIELD OF THE INVENTION

[0001] The invention relates to a data carrier and more particularly to improving the security of a data carrier by making forgery more difficult.

BACKGROUND OF THE INVENTION

[0002] Previously there are known secure documents with elements comprising text, symbols, graphics, or combinations of these. Such elements are utilized on secure documents in order to make forgery as difficult as possible. Different production methods have been developed in order to produce elements that are very difficult to reproduce (for a forger) and require different types of technical skills.

[0003] Secure documents such as identification documents may include different techniques for anti-counterfeiting the documents. These techniques include surface embossings (e.g. obtained mechanically or by etching).

[0004] However, the texts and/or graphics obtained mechanically or by etching are quite rough and always remain visible to the eye.

[0005] DOVIDs are diffractive separately originated elements based on separated material patches applied inside or onto the surface of e.g. cards. DOVIDs enable producing various visual effects: movement, colours, morphing, and hiding and revealing texts/graphics depending on the orientation of light or viewing angle.

[0006] However, a problem with DOVIDs is that they are expensive to produce and typically need to be applied one by one as patches originated onto a specific material other than a typical plastic substrate of a data carrier.

BRIEF DESCRIPTION OF THE INVENTION

[0007] An object of the present invention is to provide a method and an arrangement so as to alleviate the above disadvantages. The objects of the invention are achieved by a method and a data carrier which are characterized by what is stated in the independent claims. Further embodiments of the invention are disclosed in the dependent claims.

[0008] An aspect of the invention relates to a data carrier comprising one or more elements comprising symbols, text, graphics or combinations thereof arranged on a surface, wherein the elements are arranged on the surface as microscopic surface irregularities including protrusions, recesses or protrusions and recesses as compared to other parts of the element, said recesses or protrusions have a different recess depth or protrusion height respectively in at least one first element as compared to a corresponding background element, wherein the at least one first element is visible to a viewer only at predetermined angles of light reflection, wherein the at least one first element and the corresponding background element are arranged on the surface as an array of pixels.

[0009] A further aspect of the invention relates to a method for manufacturing a data carrier, the method comprising generating one or more elements comprising symbols, text, graphics or combinations thereof arranged on a surface, wherein the elements are arranged on the surface as microscopic surface irregularities including protrusions, recesses or protrusions and recesses as compared to other parts of the element, said recesses or protrusions have a different recess depth or protrusion height respectively in at least one first element as compared to a corresponding background element, wherein the at least one first element is visible to a viewer only at predetermined angles of light reflection, wherein the at least one first element and the corresponding background element are arranged on the surface as an array of pixels.

[0010] Although the various aspects, embodiments and features of the invention are recited independently, it should be appreciated that all combinations of the various aspects, embodiments and features of the invention are possible and within the scope of the present invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] In the following the invention will be described in greater detail by means of preferred embodiments with reference to the attached drawings, in which

Figure 1 illustrates an area divided into pixels;
Figure 2 illustrates division of pixels between surface embossed elements;
Figure 3a illustrates surface embossed elements represented by pixels having different grating directions;
Figure 4a and 4b illustrate surface embossed elements with different grating directions as appearing with different angles of light reflection;

DETAILED DESCRIPTION OF THE INVENTION

[0012] Optical variable devices (OVD) are images/patterns/elements that exhibit various optical effects, such as movement or colour changes. DOVIDs (diffractive optical variable image device) are based on diffractive optical structures, giving an appearance of different patterns, colours, and designs depending on the amount of light striking DOVID and viewing angle. OVDs and DOVIDs may be manufactured by printing and/or embossing. It is not possible to photocopy or scan OVDs/DOVIDs, and they cannot be accurately replicated or reproduced. OVDs/DOVIDs may be used as security devices and anti-counterfeiting measures on money, credit cards, passports, health insurance cards, driver's licences, and identification cards.

[0013] An exemplary embodiment relates to a technol-

ogy based on material (lamination plate) processing accuracy of picoseconds lasers. Laser processing is a form of laser-assisted etching or engraving removing copper or other metal from a plate's surface. A laser beam may have a spot size of 20 μm and may be moved with far smaller steps. The spot may have e.g. a Gaussian (i.e. TEM_{00}) power distribution, and due to a threshold power for the engraving to start, the actual marking may be much finer as well. In terms of depth accuracy e.g. 1 μm deep grooves or spots may be obtained. Such shallow grooves reflect light only in limited angles, and the maximum angle of reflection grows with increasing groove depth. By alternating groove depth and angle, it is possible to achieve effects visible at or within well controlled angles. These characteristics may be repeated onto a surface of plastic laminates and in case of transparent plastics (a window element for example) the transmitted light provides further effects at different viewing/lighting angles. Further strengths of such features are that dimensions of the grooves are so small that these are not visible to a naked eye and not even with a loupe, and that the grooves may be integrated directly into an otherwise normal looking surface as surface embossing (i. e. surface relief) having a sort of finishing touch. If the grooves are so small that they are not visible to the naked eye, they may be added to a smooth surface, and/or to be a part of another surface embossing design.

[0014] Appearance of an optically variable surface embossed element depends on the angle and direction of observation. In an exemplary embodiment, the change of appearance is achieved by surface embossed gratings with different grating directions.

[0015] In an exemplary embodiment, two or more different design elements (images) are surface embossed on an area such that they appear on the surface (at least partly) on top of each other. The area into which these images are surface embossed is divided into pixels (e.g. square shaped pixels). Figure 1 illustrates an exemplary surface embossed area divided into pixels. These pixels are then distributed between the images. For example, when two different images are embossed on the same area, one image may use every other pixel. Figure 2 illustrates distribution of the pixels between the images. In Figure 2, a first image 1 may use the pixels shown as white and the other image 2 may use the pixels shown as black.

[0016] In an exemplary embodiment, two or more different design elements (images) are surface embossed on an area such that they appear on the surface separately from each other (i.e. they do not appear on the surface on top of each other). In an exemplary embodiment, a single design element (image) is surface embossed on an area as pixels (in addition to a corresponding background element).

[0017] Figure 3a illustrates surface embossed gratings. Figure 3a illustrates the grating directions of the surface embossed gratings. Figure 3b illustrates embossed gratings showing the outline of a first image 1. The higher embossing becomes visible only at a specific angle of light reflection. A second image 2 may be surface embossed in the same way as the first image 1, but the grating direction is changed e.g. by 90 degrees compared to the grating direction of the first image 1 (see Figure 3a and 3b, "white" and "black" pixels). The images 1, 2 are formed by surface embossed gratings with a surface embossing height different from the surface embossing height of the background B1, B2. The grating comprises elongated surface embossings of different heights (e.g. 1,5 μm and 3 μm). The actual images 1, 2 are formed by a higher surface embossing, and lower surface embossings act as backgrounds B1, B2 (or vice versa), respectively.

[0018] A second image 2 may be surface embossed with the same or different recess depth/protrusion height, and/or with same or different distance between protrusion apexes/recess valleys, as the first image 1. The grating direction in image 2 may differ from the grating direction of the first image 1 e.g. by 90 degrees or by any other number of degrees.

[0019] Figure 4a and 4b illustrate optically variable surface embossed images observed with slightly different angle of light reflection. The different grating direction makes the first image 1 and second image 2 to appear/disappear at different angles of light reflection. While one image (e.g. image 1) is visible to a viewer, the background grating blends the other image (e.g. image 2) into the background B2 (and while image 2 is visible to a viewer, the background grating blends image 1 into the background B1). This makes the effect very strong since the "hidden" image disappears almost completely.

[0020] According to an exemplary embodiment, an enhanced laser processing capability enables introducing the above effects onto a laminate surface of cards and datapages (e.g. a paper-like document), potentially also other than polycarbonate.

[0021] In an exemplary embodiment, the effect is obtained onto the plastic surface by hot-embossing using a tool with the above effects arranged to the tool surface, by lamination with the above effects arranged into the surface of the lamination plate, by introducing a separate film onto the surface (before or after lamination), the film comprising these effects, or by injection moulding from a surface of a mould. A large variety of materials may be used.

[0022] In identification documents, a surface layer typically comprises plastics. However, in an exemplary embodiment, coated paper may be used instead, having a surface structure with a desired effect stamped on it (by printing with engraving press, where printing plates may be used that are manufactured in the same way as the lamination plates disclosed herein). In this context, so called security foils may be used that are laminated onto the surface of the paper after individualized printing.

[0023] The surface embossed image according to an exemplary embodiment provides a surface embossed security feature for anti-counterfeiting of secure docu-

ments (data carriers) such as identification cards, passports, health insurance cards, driver's licences, money, credit cards etc.

[0024] An exemplary embodiment enables implementing optical variability into surface embossed elements, thus making surface embossing/surface reliefs more difficult to replicate. An exemplary embodiment enables improving protection against removal attempts on graphical personalization. By means of an exemplary embodiment, latent images may be taken to a completely different level with the image disappearing from selected angles and different designs appearing from others. An exemplary embodiment allows combining the latent imagery with tactile features (sensed with finger tips) while one normally is not able to achieve both in one.

[0025] An exemplary embodiment enables a low budget manufacturing process by preparing the lamination plates (or moulds) and performing a normal lamination process of the secure document.

[0026] Thus, in an exemplary embodiment, surface embossings (i.e. surface reliefs) refer to surface irregularities comprising protrusions. In an exemplary embodiment, grooves refer to surface irregularities comprising recesses. In an exemplary embodiment, these surface irregularities are of microscopic scale. In an exemplary embodiment, the surface irregularities are elongated.

[0027] In an exemplary embodiment, a data carrier comprises one or more elements comprising e.g. symbols, text, graphics or combinations thereof arranged on a surface. The elements are arranged on the surface as microscopic surface irregularities. These surface irregularities may include grooves (i.e. recesses) that deviate from other parts of the element and/or from the surface (e.g. the actual surface level of the data carrier). Alternatively the surface irregularities may include surface embossings (i.e. protrusions) deviating from the other parts of the element and/or from the surface, or a combination of recesses and protrusions. The recesses or protrusions have a different recess depth or protrusion height respectively in at least one first element 1 and at least one second element 2 as compared to a corresponding background element B1, B2. The recesses or protrusions have a different grating direction in the at least one first element as compared to the at least one second element. The at least one first element and the at least one second element are visible to a viewer only at predetermined angles of light reflection at least partly deviating from each other. The at least one first element, the at least one second element, and the corresponding background elements are arranged on the surface as an array of pixels, such that the at least one first element and the at least one second element are represented by predetermined, different pixels.

[0028] In an exemplary embodiment, the recesses or protrusions have a different grating direction in a first background element B1 as compared to a second background element B2.

[0029] In an exemplary embodiment, the first background element B1 and the second background element B2 are represented by predetermined, different pixels. In an exemplary embodiment, the recesses or protrusions have a same grating direction in the first element 1 as compared to the first background element B1, and the recesses or protrusions have a same grating direction in the second element 2 as compared to the second background element B2.

[0030] In an exemplary embodiment, the data carrier comprises elongated (longitudinal) surface irregularities. Variations between darker and lighter parts of the elements are achievable having areas that are not grooved/surface embossed. Areas that are not grooved/surface embossed are visible to a viewer as lighter areas, and the areas with grooves/surface embossings are visible to a viewer as darker areas. This is the case if the support is of light colour, e.g. white (the surface (and the surface irregularities) may be transparent). If the support is of dark colour, e.g. black, the areas that are not grooved/surface embossed are visible to a viewer as darker areas, and the areas with grooves/surface embossings are visible to a viewer as lighter areas. If the support is transparent, the grooved/embossed areas may be visible to a viewer as lighter areas. Basically areas without surface irregularities are visible to a viewer as areas with a different tone value compared to areas having exemplary microscopic surface irregularities.

[0031] In an exemplary embodiment, the surface irregularities are light diffractive. By means of diffractive grooves/surface embossings a coloured effect is achievable. The diffractive effect may be achieved by selecting a suitable (small enough) size of the grooves/surface embossings and/or between the grooves/surface embossings (which size/distance may be material-dependent).

[0032] In an exemplary embodiment, the surface irregularities are light dispersive (they act like prisms).

[0033] In an exemplary embodiment, if the data carrier comprises N elements, every Nth element is represented by every Nth pixel at the area of the corresponding element. For example, if the data carrier comprises two elements 1, 2 (in addition to the corresponding background elements B1, B2), the second element 2 is represented by every second pixel 2 at the area of the second element 2, etc. Accordingly, if the data carrier comprises e.g. four elements, the fourth element is represented by every fourth pixel at the area of the fourth element, etc.

[0034] In an exemplary embodiment, the pixels may be divided unevenly between the images. For example, a first image may use 50% of the pixels, a second image may use 20% of the pixels, a third image may use 15% of the pixels, and a fourth image may use 15% of the pixels, at the area.

[0035] In an exemplary embodiment, if the data carrier comprises *N* elements in addition to the background elements, every *N*th background element is represented by every *N*th pixel outside the area of the corresponding element. For example, if the data carrier comprises two elements 1, 2 (in addition to the corresponding back-

ground elements B1, B2), the second background element B2 is represented by every second pixel 2 outside the area of the second element 2, etc. Accordingly, if the data carrier comprises e.g. four elements, the fourth background element is represented by every fourth pixel outside the area of the fourth element, etc.

[0036] In an exemplary embodiment, the data carrier comprises e.g. polycarbonate material, PVC material and/or polyester material.

[0037] In an exemplary embodiment, the pixels are square-shaped. However, pixels instead of square-shaped pixels, pixels of any other desired shape may be used, such as circular pixels.

[0038] In an exemplary embodiment, the array of pixels has a pixel size of about 5 μm x 5 μm to about 500 μm x 500 μm, preferably about 50 μm x 50 μm to about 250 μm x 250 μm.

[0039] In an exemplary embodiment, the surface irregularities are of a microscopic size. For example, a recess depth/protrusion height of about 1 μm to 15 μm, preferably about 1 μm to 3 μm, may be used. The distance between protrusion apexes (the highest point) may be about 1 μm to 50 μm, preferably about 12 μm to 25 μm. Similarly, the distance between recess valleys (the lowest point) may be about 1 μm to 50 μm, preferably about 12 μm to 25 μm.

[0040] In an exemplary embodiment, a method for manufacturing a data carrier is provided. The method comprises generating one or more elements comprising e.g. symbols, text, graphics or combinations thereof on a surface. The elements are arranged on the surface as microscopic surface irregularities. These surface irregularities may include grooves (i.e. recesses) that deviate from other parts of the element and/or from the surface (e.g. the actual surface level of the data carrier). Alternatively the surface irregularities may include surface embossings (i.e. protrusions) deviating from the other parts of the element and/or from the surface, or a combination of recesses and protrusions. The recesses or protrusions have a different recess depth or protrusion height respectively in at least one first element 1 and at least one second element 2 as compared to background elements B1, B2. The recesses or protrusions have a different grating direction in the at least one first element as compared to the at least one second element. The at least one first element and the at least one second element are visible to a viewer only at predetermined angles of light reflection at least partly deviating from each other. The at least one first element, the at least one second element, and the background elements are arranged on the surface as an array of pixels, such that the at least one first element and the at least one second element are represented by predetermined, different pixels.

[0041] In an exemplary embodiment, the method comprises providing a laser-engraved metal plate (i.e. a lamination plate). A plastic body is pressed by the metal plate under high temperature and pressure to generate the elements. Instead of a laser-engraved lamination plate, an etched or mechanically obtained engraved lamination plate may be used.

[0042] In an exemplary embodiment, the method comprises laser-engraving a plastic body to generate the elements. Instead of laser-engraving the plastic, etching or mechanical engraving of the plastic may be utilized.

[0043] In an exemplary embodiment, the method comprises providing a laser-engraved injection mould, and injection moulding a plastic body by the laser-engraved injection mould to generate the elements. Instead of a laser-engraved injection mould, an etched or mechanically obtained engraved injection mould may be used.

[0044] In an exemplary embodiment, a spot size of e.g. about 1 μm to 50 μm, preferably about 6 μm to 20 μm, of a laser beam is used for laser-engraving. The spot may have a Gaussian power distribution (i.e. TEM_{00}), for example. Another option is that the spot has e.g. a TEM_{10} or any other suitable power distribution.

[0045] It will be obvious to a person skilled in the art that, as the technology advances, the inventive concept can be implemented in various ways. The invention and its embodiments are not limited to the examples described above but may vary within the scope of the claims.

Claims

1. A data carrier comprising
   one or more elements comprising symbols, text, graphics or combinations thereof arranged on a surface,
   wherein the elements are arranged on the surface as microscopic surface irregularities including protrusions, recesses or protrusions and recesses as compared to other parts of the element,
   said recesses or protrusions have a different recess depth or protrusion height respectively in at least one first element (1) as compared to a corresponding background element (B1),
   wherein the at least one first element is visible to a viewer only at predetermined angles of light reflection,
   wherein the at least one first element and the corresponding background element are arranged on the surface as an array of pixels.

2. A data carrier as claimed in claim 1, **characterized in that** said recesses or protrusions have a different recess depth or protrusion height respectively in at least one first element (1) and at least one second element (2) as compared to a corresponding background element (B1, B2),
   said recesses or protrusions have a different grating direction in the at least one first element as compared to the at least one second element,
   wherein the at least one first element and the at least one second element are visible to a viewer only at

predetermined angles of light reflection at least partly deviating from each other,
wherein the at least one first element, the at least one second element, and the background elements are arranged on the surface as an array of pixels, such that the at least one first element and the at least one second element are represented by predetermined, different pixels.

3. A data carrier as claimed in claim 2, **characterized in that** said recesses or protrusions have a different grating direction in a first background element as compared to a second background element.

4. A data carrier as claimed in claim 2 or 3, **characterized in that** the first background element and the second background element are represented by predetermined, different pixels.

5. A data carrier as claimed in claim 2, 3 or 4, **characterized in that**
said recesses or protrusions have a same grating direction in the first element as compared to the first background element; and
said recesses or protrusions have a same grating direction in the second element as compared to the second background element.

6. A data carrier as claimed in any of claims 2 to 5, **characterized in that** the at least one first element and the at least one second element appear on the surface as at least partly overlapping.

7. A data carrier as claimed in any of claims 1 to 6, **characterized in that** if it comprises *N* elements in addition to background elements, every Nth element is represented by every *N*th pixel at the area of the corresponding element.

8. A data carrier as claimed in claim 7, **characterized in that** if it comprises *N* elements in addition to the background elements, every Mh background element is represented by every *N*th pixel outside the area of the corresponding element.

9. A data carrier as claimed in any of claims 1 to 8, **characterized in that** said microscopic surface irregularities comprise elongated surface irregularities.

10. A data carrier as claimed in any of claims 1 to 9, **characterized in that** it comprises one or more of polycarbonate material, PVC material or polyester material.

11. A data carrier as claimed in any of claims 1 to 10, **characterized in that** the pixels are square-shaped and/or circular.

12. A data carrier as claimed in any of claims 1 to 11, **charac- terized** in that the array of pixels has a pixel size of about 5 μm x 5 μm to about 500 μm x 500 μm, preferably about 50 μm x 50 μm to about 250 μm x 250 μm.

13. A data carrier as claimed in any of claims 1 to 12, **charac- terized** in that the recess depth is about 1 μm to 15 μm, preferably about 1 μm to 3 μm.

14. A data carrier as claimed in any of claims 1 to 13, **charac- terized** in that the protrusion height is about 1 μm to 15 μm, preferably about 1 μm to 3 μm.

15. A data carrier as claimed in any of claims 1 to 14, **charac- terized** in that a distance between protrusion apexes and/or recess valleys is about 1 μm to 50 μm, preferably about 12 μm to 25 μm.

16. A data carrier as claimed in any of claims 1 to 15, **characterized in that** it comprises areas without the surface irregularities, such that the areas without surface irregularities are visible to a viewer as areas with a different tone value compared to areas having the microscopic surface irregularities.

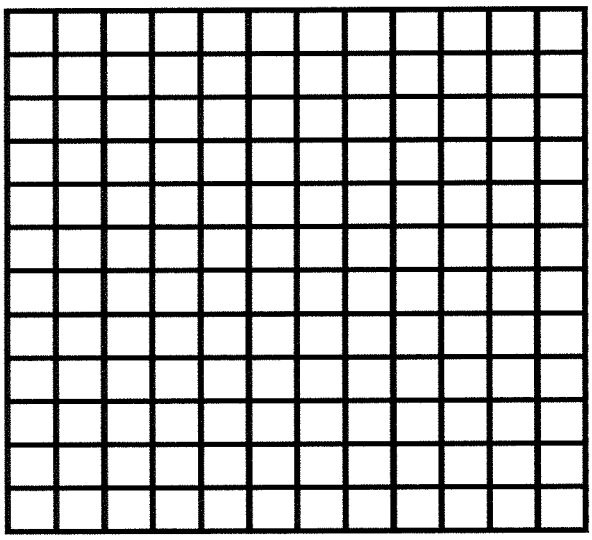

Fig. 1

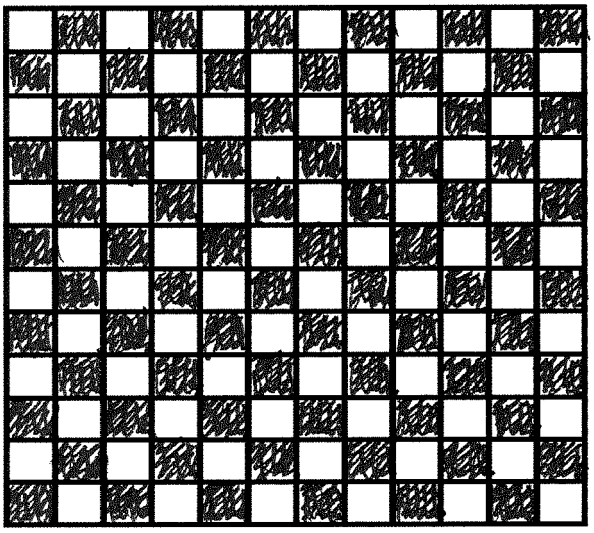

Fig. 2

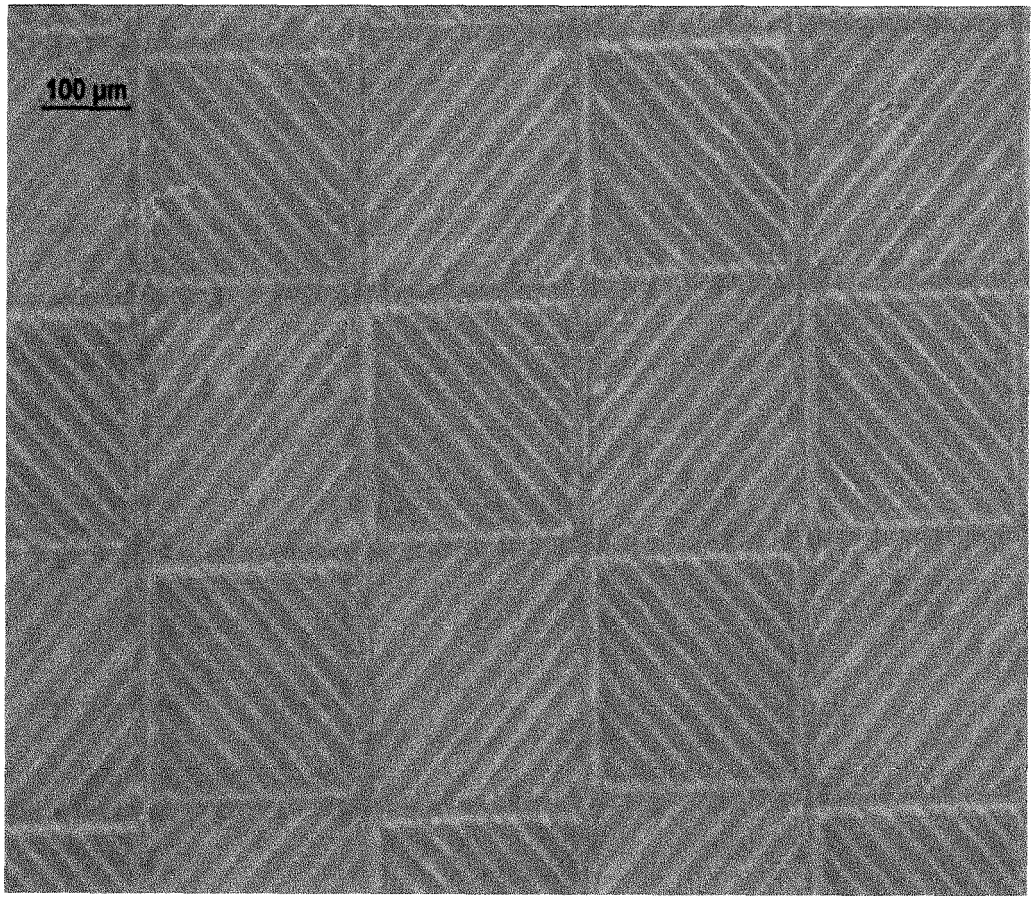

Fig. 3a

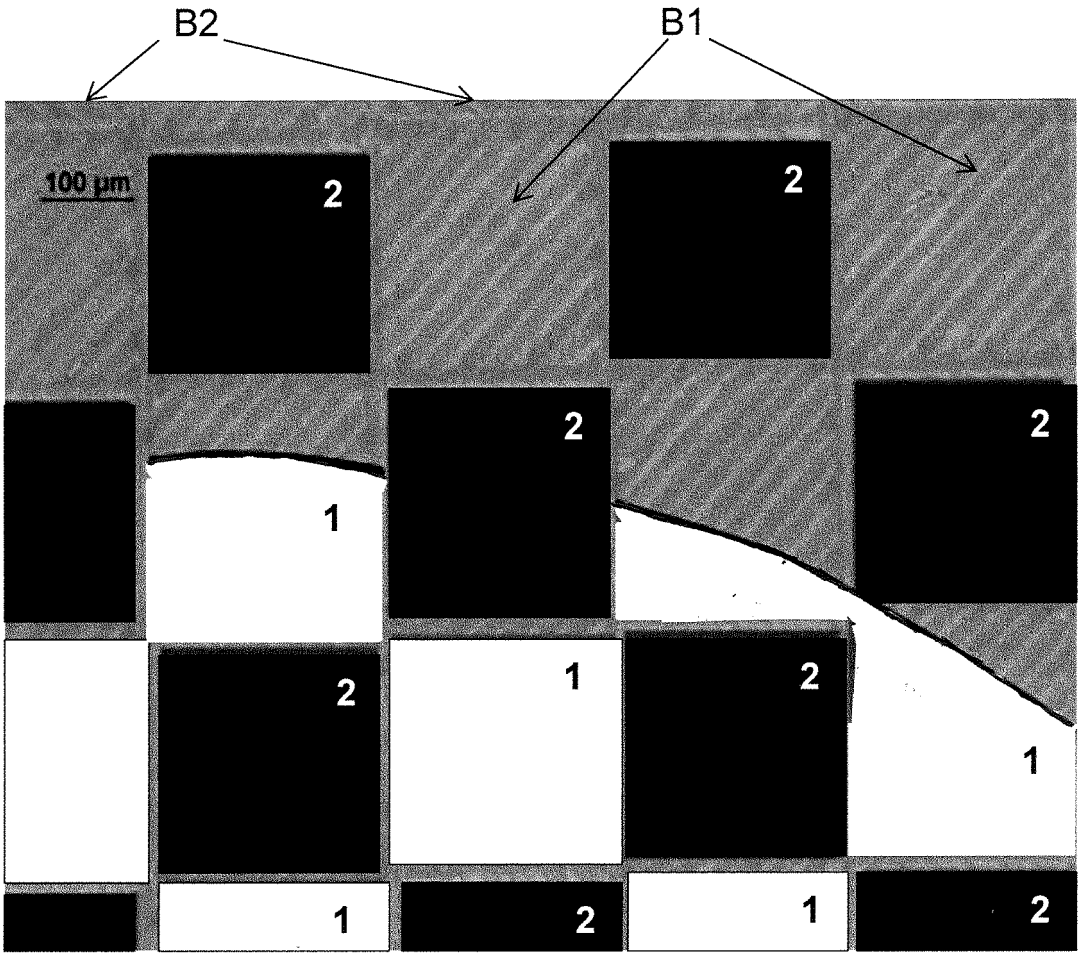

Fig. 3b

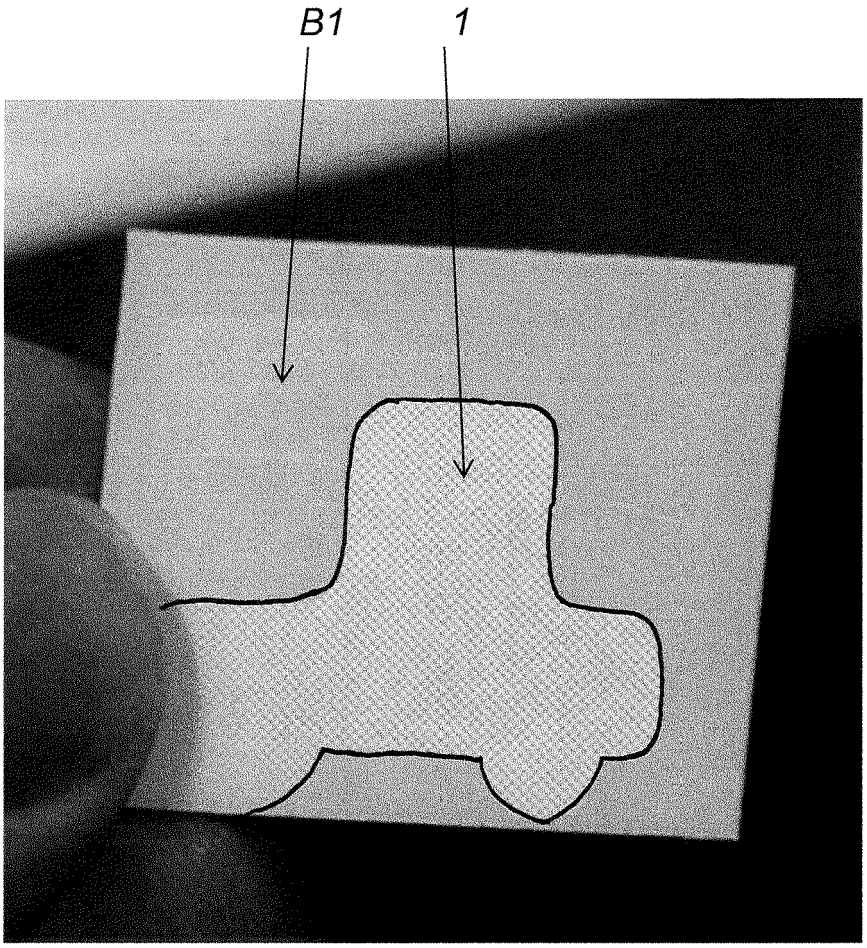

Fig. 4a

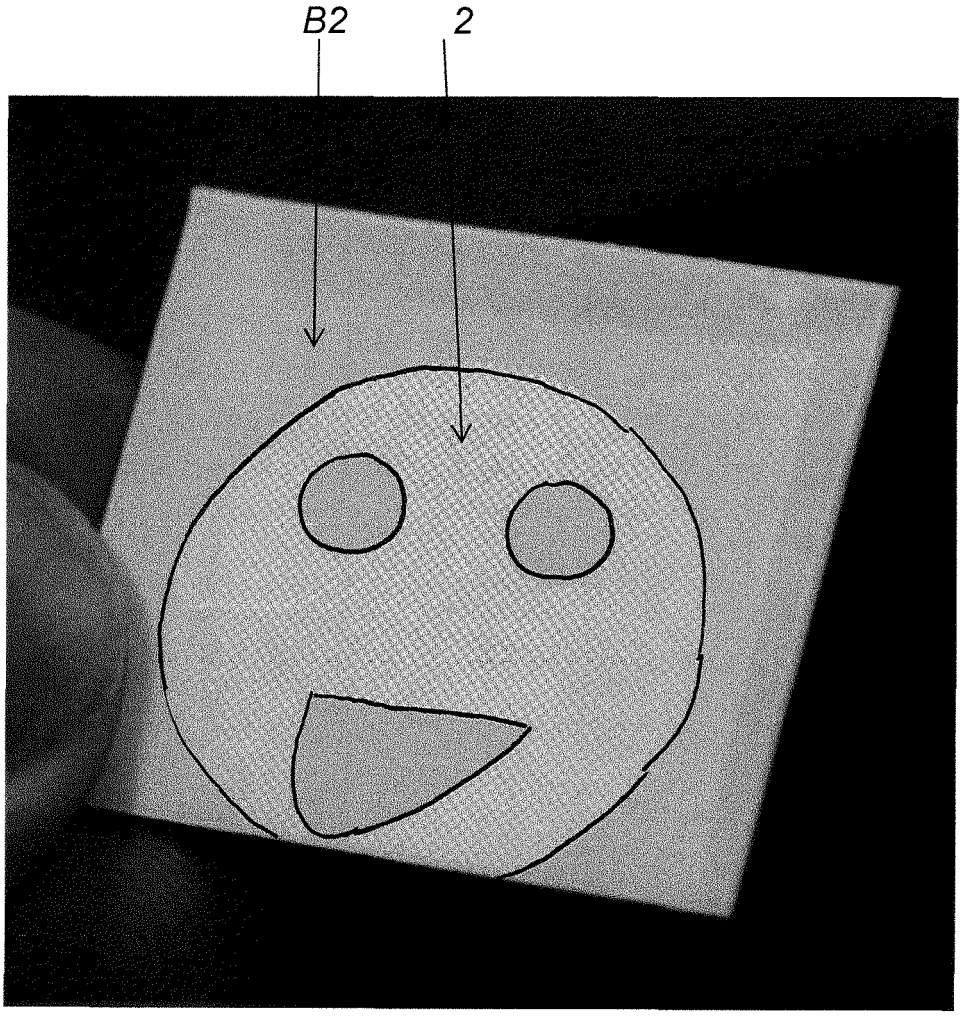

Fig. 4b

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EUROPEAN SEARCH REPORT

Application Number
EP 14 30 5561

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 02/091041 A1 (COMMW SCIENT IND RES ORG [AU]; LEE ROBERT ARTHUR [AU]) 14 November 2002 (2002-11-14) * Abstract; Page 3, line 25-page 6, line 1; Page 7, line 28-page 10, line 3; figures 1-4.6-11 *	1-16	INV. B42D15/00 B42D25/00 G07D7/00
X	US 7 686 341 B2 (ADAMCZYK ROGER [DE] ET AL) 30 March 2010 (2010-03-30) * Abstract; column 2, line 50 - column 3, line 56; figures 1,2,11,12,13 * * columns 8,9 *	1-16	
X	US 4 033 059 A (HUTTON ROBERT GORDON ET AL) 5 July 1977 (1977-07-05) * Abstract; Col 2, line 29 - col 6, line 14; Col 10; Col 14, lines 27-62; Col 18; claims 1-4; figures 1-20 *	1-16	TECHNICAL FIELDS SEARCHED (IPC) B42D G07D B41M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	19 September 2014	Callan, Feargel

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 14 30 5561

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19-09-2014

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82