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(54) METHOD FOR PRODUCING DATA CARRIER AND DATA CARRIER PRODUCED THEREOF

(57) A method of forming a data carrier for a security document, the method comprising: providing a first outer layer and a second outer layer, forming a first security feature at the interface between at least two adjacent layers, said first security feature comprising a first deformation of surface of one of the layers, forming a stacked structure with said first outer layer and said second outer layer, said stacked structure being formed by lamination, wherein the first deformation of the surface of one of the layer is replicated during lamination such that at least one replicated deformation is formed inside the data carrier at the interface between at least some of the layers.

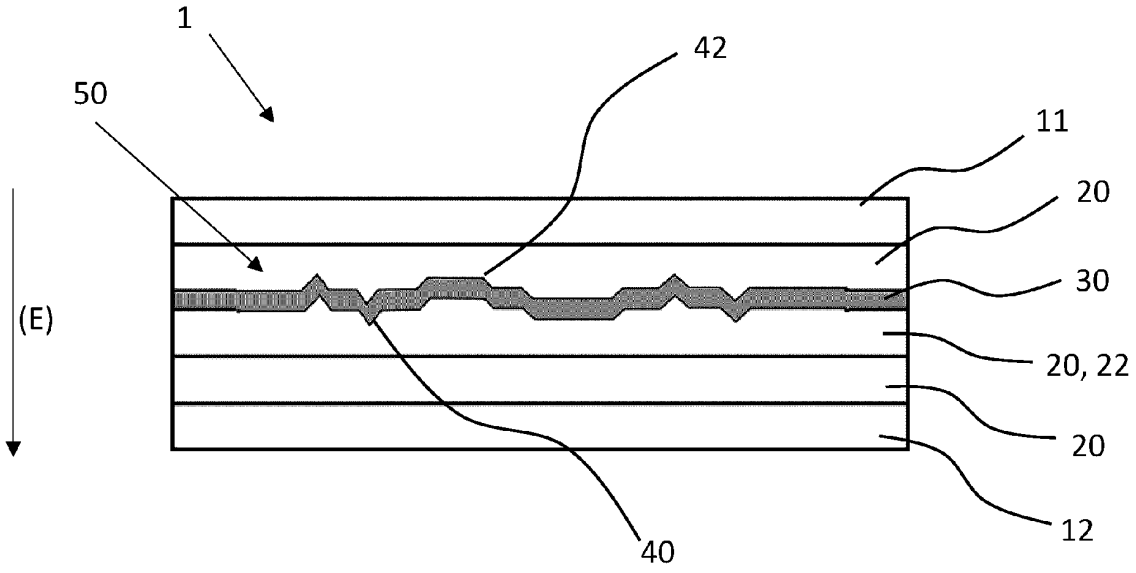

Fig. 3

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Description

TECHNICAL FIELD

[0001] The present invention relates to method of producing a data carrier, to a data carrier produced thereof and to a security document comprising or consisting of such a data carrier.

PRIOR ART

[0002] Data carriers for security documents such as identity cards, passports or the like typically comprise at least one security element. Said security element can be provided on a top surface of the data carrier. Well-known method to protect data is surface embossing made by lamination plates. The weakness of such method is the fact that the security feature can be copied, removed and/or replaced. It is also possible to produce look-alike surface embossing by means of desktop printing, combination of glue & suitable particles, etc. Thus, such security elements are prone to forgery.

SUMMARY OF THE INVENTION

[0003] It is an object of the present invention to provide a method of forming a data carrier especially for a security document of greater security that is less prone to forgery.

[0004] This object is achieved with a method according to claim 1. In particular, a method of forming a data carrier for a security document is provided, the method comprising:

- providing a first outer layer and a second outer layer,
- forming a first security feature at the interface between at least two adjacent layers, said first security feature comprising a first deformation of surface of one of the layers, and
- forming a stacked structure with said first outer layer and said second outer layer, said stacked structure being formed by lamination,

wherein the first deformation of the surface of one of the layer is replicated during lamination such that at least one replicated deformation is formed inside the data carrier at the interface between at least some of the layers.

[0005] This method allows forming a security feature fully inside the data carrier, said security feature surviving in lamination, leaving a pre-made and designed deformation at the interface between some of the layers. This first security feature can also be referred to as an interfacial security feature, as it is located at the interface between some of the layers of the data carrier. As the security feature is inside the data carrier, removal of data becomes more complicated, as grinding of the data carrier would remove simultaneously also the designed deformation. Also, as the first deformation is formed before forming the stack structure of the data carrier by lamination, a modification of said first deformation and the corresponding security feature after the lamination step would be particularly difficult for a forger. Therefore, the security feature is less prone to copy, reproduction or modification by a forger. The data carrier obtained by this method allows subsequent personalization such as laser engraving. In the same way, this method of marking the data carrier does not interfere with embossing or diffractive surface elements in a negative way. It enables various possibilities in terms of design and feature visibility, it can be overt or covert, if required. Finally, this method can leave the outer surface of the data carrier fully smooth and intact.

[0006] This method is particularly advantageous as it is compatible with a wide range of techniques for forming the first deformation, therefore allowing for a strong compatibility with existing methods and installations. Indeed, the first deformation of the surface of one of the layers can be produced by deformation of matter, by added matter and/or by removal of matter. The different techniques for forming the first deformation of surface of one of the layers will be further discussed later.

[0007] The method according to the invention can comprise one of the following features, taken individually or in any possible combination:

- the data carrier comprises at least one revealing layer facing the first deformation of surface of one of the layers such that the revealing layer is in contact with said first deformation of surface of one of the layers,
- the revealing layer comprises a replicated deformation,
- the at least one revealing layer covers a surface bigger than the surface covered by the first deformation of surface of one of the layers,
- the at least one revealing layer covers substantially all the surface of the layer with the first deformation,
- the data carrier comprises at least one inner layer,
- the inner layer comprises the deformation,
- the at least one inner layer comprises a core layer,
- the core layer comprises the first deformation
- the first deformation of surface of one of the layers is formed by heating said layer,
- the first deformation of surface of one of the layers is preferably formed by laser cutter, by laser deformation, by pre-lamination, by hot stamping and/or by welding of said layer,
- the first deformation of surface of one of the layers is formed without heating said layer,
- the first deformation of surface of one of the layers is formed by knife cutter and/or by use of a lacquer or varnish to create an embossing on said layer,
- the first deformation of surface of one of the layers is formed by deformation of matter of said layer,
- the first deformation of surface of one of the layers is formed by laser deformation, by pre-lamination, by hot stamping and/or by welding of said layer,

- the first deformation of surface of one of the layers is formed by addition of matter to the surface of said layer,
- the first deformation of surface of one of the layers is formed by use of a lacquer or varnish to create an embossing on said layer,
- the first deformation of surface of one of the layers is formed by removal or ablation of matter of said layer,
- the first deformation of surface of one of the layers is formed by knife cutter and/or laser cutter,
- the method comprises a step of forming a second security feature,
- the second security feature is formed by laser engraving,
- the method comprises a step of forming a personalization element,
- the personalization element at least partially overlapping the first security feature along the extension direction,
- the method comprises a step of forming a see-through portion,
- the see through portion at least partially overlapping the first security feature along the extension direction of the data carrier,
- the personalization element at least partially overlapping the see through portion and the first security feature along the extension direction.

[0008] The layers of the data carrier preferably comprises or consists of at least one plastics and/or of one or more polymers such as thermoplastic polymer or thermoset polymer. The layers of the data carrier preferably comprise or consists of polycarbonate (PC) and/or polyvinyl chloride (PVC) and/or polyethylene terephthalate (PET) and/or polyethylene (PE) and/or cross-linked polyethylene and/or polypropylene (PP) and/or copolymers thereof and/or mixtures thereof. The layers of the data carrier are not necessarily of the same material. It is furthermore preferred that the data carrier is provided by means of one or more layers, i.e. it preferably corresponds to a layered structure. The data carrier particularly preferably corresponds to a card body as it is known in the field of the invention.

[0009] Depending on the technique for forming the first deformation, different type of deformation can be produced with different strength and a wide range of depth, height, width and profile of the deformation. Depending of this strength of deformation, the visibility of the marking may vary. The marking can be overt and visible for bare eyes. On the other hand, the marking may be covert and require use of a magnification such as a loupe, a microscope and/or different lighting conditions in order to be visible.

[0010] The term "replicated deformation" correspond to the deformation of layers which are adjacent to the layer with the first deformation of surface. Said replicated deformation is induced by the first deformation through lamination process. The first deformation of surface of one of the layer is replicated to at least one adjacent layer. Said first deformation can be replicated to several adjacent layers such that the data carrier formed by the present method comprises several replicated deformation of the first deformation of surface of one of the layers. However, the replicated deformation is not on the outermost surface of the data carrier obtain by the present method. The replicated deformation and the first deformation are in alignment along the extension direction (E). The replicated deformation has a profile sensibly similar to the profile of the first deformation. In other words, if the deformation comprises recesses, bumps and/or dips, the replicated deformation includes similar recesses, bumps and/or dips. However, the height and depth of the recesses, bumps and/or dips of the replicated deformation along the extension direction (E) may be of lower height and depth than those of the original deformation, the amplitude of the recesses, bumps and/or dips of the replicated deformation being therefore reduced compared to said original deformation along the extension direction (E).

[0011] The structure of the data carrier can comprises several inner layers. Among those inner layer, the data carrier can comprise a core layer. Advantageously, at least one inner layer such as the core layer comprises the first deformation.

[0012] Preferably, the data carrier comprises at least one revealing layer. The revealing layer increase and/or improve the visibility of the first deformation and the security feature once the stacked structure of the data carrier is formed. The revealing layer is preferably selected with respect to the internal layer carrying the first deformation. Advantageously, the chemical composition and physical properties of the revealing layer are not identical with those of the inner layer with the first deformation of surface. The revealing layer is preferably adjacent to the layer with the first deformation. The revealing layer advantageously faces the first deformation of surface of one of the layers such that said revealing layer is in contact with the first deformation of surface of one of the layers. The revealing layer can also faces the rear side of the layer with the first deformation on its front side. The revealing layer can also be separated from the first deformation of surface of one of the layers by some inner layers in between.

[0013] The first deformation is replicated on the revealing layer during lamination such that said revealing layer comprises a replicated deformation. The first deformation of surface is not formed directly on the revealing layer. On the contrary, the first deformation is formed on a different layer, such as a first inner layer, and will be replicated to the revealing layer only through lamination. Consequently, the revealing layer can be welded to a second inner layer as a pre form. Once the first deformation of surface is formed on a layer such as a first inner layer, said pre form is applied onto the first inner layer, with the revealing layer.

[0014] As the deformation is formed on another sur-

face rather than directly on a revealing layer or an ink layer, said revealing layer is not damaged by the deformation. This also allows a strong compatibility with a large number of deformation techniques, as it will be discussed in more details below. Another benefit coming from this approach is that the feature is more attractive and has more dimensions when the deformation and revealing layer are not precisely in the same interface.

[0015] The revealing layer is not necessary have the same surface as the first deformation. According to one embodiment, the at least one revealing layer covers a surface bigger than the surface covered by the first deformation of surface of one of the layers. The security feature is therefore not formed only in the portion where the revealing layer is present but rather on the portion where the first deformation of surface is present. In this case, the revealing layer does not need to be cut or preformed in order to define the shape or area of the desired security feature. The revealing layer can cover substantially all the surface of the layer with the first deformation. According to another embodiment, the at least one revealing layer covers a surface smaller than the surface covered by the first deformation of surface of one of the layers. In this case, the whole revealing layer shows the desired effect while the deformation outside the revealing layer can disappear during lamination process.

[0016] The first deformation can be formed on any of the layers as it is not on the outermost surface of the data carrier. For example, the first deformation can be formed on an inner surface of one of the outer layer. This first deformation can also be formed on a surface of one of the inner layers. The at least one inner layer preferably comprises a so-called core layer, the first deformation being formed on the surface of said core layer. The core layer is preferably substantially at the center of the stacked structure. Said core layer can also comprises several sub layers. Such a multilayered core can be deformed and then laminated to the revealing layer along with the outer layers.

[0017] The core layer carrying the first deformation of surface can be substantially transparent. Alternatively, said core layer carrying the first deformation of surface can be colored, advantageously white. Depending on the appearance of the core layer, the revealing layer can have different composition and appearance.

[0018] As mentioned above, one of the advantages of the method of the invention is that it is compatible with a wide range of techniques for forming the first deformation of surface of one the layers. These different techniques can be classified into different categories. The deformation of surface of one of the layers can be formed by heating said layer or without heating said layer. It can also be formed by deformation of matter of the layer, by addition of matter to the surface of said layer, or by removal or ablation of matter of said layer. All those categories comprising different techniques which all present specific advantages and properties.

[0019] As previously mentioned, a first type of technique to form the first deformation of surface of one of the layers is by heating said layer. The use of heat to deform a surface of a polymeric layer, notably a polycarbonate layer, encompass several different techniques.

[0020] Using heat to form the first deformation of surface of one of the layers enables quicker process with less pressure and a higher definition when small details are created for some layers.

[0021] Among those techniques using heat to form the first deformation of surface, a first technique is using laser cutting. Laser cutting technique can be used to form a kiss-cut or a through cut.

[0022] A kiss cut of a layer consists in cutting a material layer such that the cut does not go through the whole thickness of said layer.

[0023] A through cut of a layer consists in cutting a material layer such that the cut goes through the whole thickness of said layer.

[0024] The use of laser cutter has a high degree of freedom in terms of design. An entire sheet can be treated, one sheet at a time.

[0025] The shape of the deformation, when observed in a cross cut along a direction perpendicular to the extension direction (E), can be qualified as rounded or soft.

[0026] When forming the first deformation on the surface of one the layers, the tooling (i.e. laser) causes melting and/or ablation of the material. Depending on the treated material, marking by laser may cause fluorescence.

[0027] This laser cutter technique allows for a high degree of freedom regarding card structure as a high number of shape is possible to produce when forming the first deformation.

[0028] This laser cutter technique has the advantage to not require consumable to change along the process. Also, the revealing layer is not mandatory with this method of forming the first deformation.

[0029] Another technique using heat to form the first deformation is pre lamination. With such technique, the layer with the first deformation is laminated by using embossing plates. This step is distinct from the lamination step for forming the stack structure of the data carrier. This pre-lamination step can be performed with the same equipment as for the lamination step for forming the stack structure of the data carrier, but preferably with a shorter lamination time and thinner stack of sheets for the pre-lamination.

[0030] The use of pre lamination step to form the first deformation allows a high degree of freedom in terms of design. An entire sheet can be treated. Very small design are possible to produce as the deformation can have a height starting from 2 μm, and line width starting from 10μm. The plate used to emboss the surface of the layer on which the first deformation is formed defines the design as well as the level of details.

[0031] The shape of the deformation, when observed

in a cross cut along a direction perpendicular to the extension direction (E), can be rounded. Said deformation depends on the shape of the embossing plate / lamination plate.

[0032] This pre lamination technique allows for a high degree of freedom regarding card structure as a high number of shape is possible to produce when forming the first deformation.

[0033] The pre lamination technique allows forming overt and covert security feature in the final data carrier. Advantageously, the pre lamination technique allows forming high resolution repeatable details on the surface of the deformed layer.

[0034] Preferably, a revealing layer is provided against the deformed layer once the first deformation has been formed by pre lamination.

[0035] This pre lamination technique also have the advantage of presenting low risk of forming unwanted deformation.

[0036] Another technique using heat to form the first deformation is hot stamping. With such technique, the layer on which the first deformation is formed is embossed.

[0037] This kind of embossing can be performed by known process of the state of the art. For example, this hot stamping process can be performed by Gietz hot stamping machine, roll-to-sheet, with preferably a 100 μm thick plastic.

[0038] The use of hot stamping step to form the first deformation allows a good degree of freedom in terms of design. An entire sheet can be treated, but only one sheet at a time. Very small design are possible to produce as the deformation can have a height starting from 2 μm, and line width starting from 10μm. The plate used to emboss the surface of the layer on which the first deformation is formed defines the design as well as the level of detail.

[0039] The shape of the deformation, when observed in a cross cut along a direction perpendicular to the extension direction (E), can be rounded. Said deformation depends on the shape of the tooling.

[0040] This deformation technique is not the most easy to implement as some parasite or unwanted deformation may be created by the tooling when forming the first deformation on the surface of the deformed layer. This technique however benefits from the availability of the tooling as the hot stamping is a widely spread technique in the field of security documents. This technique can notably be used with DOVID foils.

[0041] This hot stamping technique allows for a high degree of freedom regarding card structure as a high number of shape is possible to produce when forming the first deformation.

[0042] The hot stamping technique allows forming overt and covert security feature in the final data carrier.

[0043] Preferably, a revealing layer is provided against the deformed layer once the first deformation has been formed by hot stamping.

[0044] Another technique using heat to form the first deformation is ultrasonic welding. Ultrasonic welding corresponds to a process that uses mechanical vibrations in the ultrasonic range. These vibrations, produced by a sonotrode, as it is generally known, are used to act on at least part of deformed layer, whereby the first deformation is produced. To this end it is preferred that the deformed layer is placed on an anvil as it is known in the art as well, and wherein the sonotrode is pressed onto the layer on a side being opposite the anvil. The ultrasonic welding is preferably performed using an ultrasonic welding device as it is known in the art. The ultrasonic welding device is preferably commercially available.

[0045] The use of ultrasonic welding step to form the first deformation allows a high degree of freedom in terms of design. Ultrasonic welding enables fine details such as microtext and furthermore enables the generation of various features such as optically variable element, and notably latent images. The marking can be overt and visible for bare eyes. On the other hand, the marking may be covert and require use of a magnification such as a loupe, a microscope and/or different lighting conditions in order to be visible.

[0046] Preferably, a revealing layer is provided against the deformed layer once the first deformation has been formed by welding.

[0047] In opposition to the aforementioned techniques, another type of technique to form the first deformation of surface of one of the layers is without heating said layer.

[0048] Among those techniques not using heat to form the first deformation, a first technique is using knife cutting. Knife cutting technique can be used to form a kiss-cut or a through cut.

[0049] With this technique, an entire sheet can be treated, one sheet at a time. The shape of the deformation, when observed in a cross cut along a direction perpendicular to the extension direction (E), can be qualified as sharp.

[0050] The implementation of such technique of deformation is sensibly easy and benefits from the availability of the tooling as the knife cutting is a widely spread technique in the field of security documents. However, such techniques require maintenance as the blade used to cut the layers has to be replaced regularly in order to maintain a good quality of cutting. In addition, the knife cutting is not the fastest deformation technique among those discussed herein.

[0051] Another type of technique not using heat to form the first deformation is the use of lacquer, varnish or any other suitable substance that can be added on the surface by printing, coating, spraying, etching, etc. By bringing added matter on the surface of a given layer, the surface profile of said layer is deformed and the first deformation of surface is formed. The added matter can be for instance lacquer or varnish such as printable silk screen varnish.

[0052] This technique has a high degree of freedom in terms of design as the shape of the deformation is free.

[0053] In addition to the above-mentioned methods

using no heat, a cold press technique could also allow to form a first deformation of surface of one of the layers.

[0054] Another type of technique to form the first deformation of surface of one of the layers is by deformation of matter of said layer. By deformation of matter, it is meant here that no matter is added nor ablated from the layer. The deformation of matter a layer encompass several different techniques. Among those techniques can be cited pre lamination, hot stamping and welding of the layer.

[0055] This type of technique has the advantage of not using any consumables. These methods only consume energy.

[0056] Another type of technique to form the first deformation of surface of one of the layers is by addition of matter on said layer. By addition of matter, it is meant here that matter is added to the layer. The addition of matter on a layer encompass several different techniques. Among those techniques can notably be cited the use of lacquer or varnish in order to create an embossing on the surface of the layer.

[0057] This type of technique has the advantage of being compatible with a large number of material as there are numerous substances that can be used for this purpose. For instance: offset inks, silk screen inks, varnishes, adhesives, fibers, metal wire, etc. Substance to be added can be colored or colorless. These methods can be fast and require low investment.

[0058] Another type of technique to form the first deformation of surface of one of the layers is by removal or ablation of matter of said layer. By removal or ablation of matter, it is meant here that matter is removed from the layer. The removal of matter a layer encompass several different techniques. Among those techniques can notably be cited knife cutting and laser cutting.

[0059] This type of technique is fast and requires no consumables. Also, ablation has no side effect of heating. However, type of technique consumes more energy than some other techniques mentioned previously.

[0060] Depending on the existing installation and configuration, some of the aforementioned techniques will require less modification than others and therefore would be a better choice.

[0061] Also, depending on the type of polymeric layer used to form the data carrier, some technique to form the first deformation of surface of one of the layers will be more adapted.

[0062] Further to this wide compatibility in term of techniques for forming the first deformation of surface of one the layers, the method according to the invention is also advantageously compatible with addition of other security features and subsequent personalization. Indeed, as mentioned before, this method of marking the data carrier does not interfere with embossing or diffractive surface elements in a negative way.

[0063] Advantageously, the method according to the invention comprises a step of forming a second security feature. Said second security feature can be formed by a modification of the surface of the data carrier. The second security feature can be of many types as a modification of the uppermost surface of the data carrier will not interfere with the first security feature as said first security feature is a so called interfacial feature at the interface between at least some of the layers of the data carrier. In this case, the step of forming the second security feature is subsequent the step of forming the stack structure by lamination.

[0064] The second security features can notably be a latent image, an embossing, a debossing, a diffractive feature and a watermark.

[0065] Advantageously, the second security feature is formed by laser engraving. The laser engraving of the data carrier formed by the method according to the invention allows forming a second security feature with high level of complexity and reliability while not interfering with the first security feature.

[0066] The second security feature can also be an interfacial feature formed with the method according to the invention. In that case, the step of forming the second security feature comes before the step of forming the stack structure by lamination.

[0067] Preferably, the second security feature is at least partially overlapping the first security feature along the extension direction (E).

[0068] Advantageously, the method comprises a step of forming a personalization element. Said personalization element can be formed by many different techniques well known from the state of the art. Advantageously, the personalization element is formed by laser engraving. Preferably, said personalization element is at least partially overlapping the first security feature along the extension direction (E). This overlapping allows forming particularly complex design which would be very difficult for a forger to reproduce and/or to selectively alter.

[0069] Advantageously, the method comprises a step of forming a see-through portion or a window. The see-through portion can be produced by forming a void in one or more layers of the data carrier, allowing visibility through the data carrier. The void can be formed by punching or cutting away some material from one or more layers of the data carrier. In the context of the invention, the see-through portion allows viewing at least part of the deformation and/or the replicated deformation of the security feature.

[0070] Preferably, said see-through portion is at least partially overlapping the first security feature along the extension direction (E). This overlapping allows forming particularly complex design which would be very difficult for a forger to reproduce and/or to selectively alter.

[0071] According to another aspect, the invention concerns a data carrier obtained by the method previously disclosed. In particular, the data carrier according to the invention extends along an extension direction (E) and comprises:

- a first outer layer forming a first outer surface of the

data carrier,

- a second outer layer forming a second outer surface of the data carrier, and
- at least one inner layer between the first outer layer and the second outer layer,

said first outer layer, said second outer layer and said at least one inner layer forming a stacked structure, wherein the data carrier comprises a first security feature at the interface between at least two adjacent layers, said first security feature comprising a first deformation of surface of one of the layers and at least one replicated deformation induced by the first deformation.

[0072] All the technical advantages presented above in relation with the method of forming a data carrier applies equally to the data carrier according to the invention.

[0073] The data carrier structure can comprises several inner layers. Preferably, the at least one inner layer comprises at least one revealing layer. The revealing layer increase and/or improve the visibility of the first deformation and the security feature once the stacked structure of the data carrier is formed. The revealing layer is preferably selected with respect to the internal layer carrying the first deformation. Advantageously, the chemical composition and physical properties of the revealing layer are not identical with those of the inner layer with the first deformation of surface. The revealing layer advantageously faces the first deformation of surface of one of the layers such that said revealing layer is in contact with the first deformation of surface of one of the layers. The revealing layer can also be separated from the first deformation of surface of one of the layers by some inner layers in between. The revealing layer can also faces the rear side of the layer with the first deformation on its front side.

[0074] The first deformation is replicated on the revealing layer during lamination such that said revealing layer comprises a replicated deformation.

[0075] Preferably, the at least one revealing layer comprises offset inks and varnishes, silk screen printing inks and varnishes, DOVID (Diffractive Optically Variable Image Device), OVI (Optically Variable Ink), pearlescent inks, metallic inks, metallic foils, and/or a colored plastic film.

[0076] Advantageously, the revealing layer covers substantially all the surface of the layer with the first deformation. The security feature is therefore not formed only in the portion where the revealing layer is present but rather on the portion where the first deformation of surface is present. This allows simplifying the manufacturing process as the revealing layer does not need to be cut or preformed in order to define the shape or area of the desired security feature.

[0077] Advantageously, the data carrier comprises a so-called core layer comprising the first deformation on its surface. The core layer is an inner layer of the data carrier. The core layer is preferably substantially at the center of the stacked structure. Said core layer can also comprises several sub layers.

[0078] As presented before, the first deformation of one of the layers and consequently the first security feature can be formed by many different techniques. As already mentioned above, the term deformation of surface of a given layer encompass different types of deformation of surface such as deformation of matter of the given layer, addition of matter on the given layer and removal of matter of the given layer. The techniques presented above can be classified in one of these three categories. Depending on the type of technique, the type of first security feature can vary. Said first security feature of the data carrier can be overt and visible for bare eyes. On the other hand, the marking may be covert and require use of a magnification such as a loupe, a microscope and/or different lighting conditions in order to be visible.

[0079] Advantageously, the first security feature of the data page can comprise at least one of a latent image, an embossing, a debossing, microtext, optically variable elements and a watermark-like feature. Some of these security features, such as latent images for example, can become visible when suitably altering the viewing and/or lighting angle. Some other security features, such as watermark like for example, can become visible or more prominent under backlight conditions compared to any other lighting configuration.

[0080] The security element preferably has the shape of a pattern. The pattern can be an ordered pattern or a disordered pattern. An ordered pattern preferably comprises pattern elements being arranged in a repetitive manner. A disordered pattern preferably comprises randomly distributed pattern elements. The pattern elements in both cases can correspond to geometric shapes such as lines or circles or the like, a barcode, or any random looking set of elements. A security element being inspectable by the bare human eye is understood as being verifiable without the need of any dedicated equipment. A machine-readable security element is understood as being verifiable by means of dedicated equipment, e.g. by means of a mobile phone that takes a photograph of the security element and being configured to perform a software-based verification of the pattern. A phone operates in visible light regarding the light source as well as the capture. However, the verification could likewise require specific lighting conditions such as ultraviolet lighting or infrared lighting, and the same applied to the capturing device. Furthermore, the verification could require magnification of some level if the security element is provided at very high resolution.

[0081] The first outer layer and/or the second outer layer may be formed by different material adapted for their use in security documents and data carrier such as PVC, PETG, ABS and so on. Advantageously, the first outer layer and/or the second outer layer comprises thermoplastic material. Preferably, the first outer layer and/or the second outer layer comprises polycarbonate.

[0082] In the same way, the at least one core layer may be formed by different material adapted for their use in security documents and data carrier such as PVC, PETG, ABS and so on. Advantageously, the at least one core layer comprises thermoplastic material. Preferably, the at least one core layer comprises polycarbonate and more preferably transparent polycarbonate.

[0083] The outer layers and the core layer do not have to be of same type. For instance, a data carrier with PET core and PVC surface layers could be manufactured according to the method of the invention.

[0084] Advantageously, the data carrier according to the invention comprises a second security feature. Said second security feature can be formed by a modification of the surface of the data carrier. In that case, the second security feature can be of many types as a modification of the uppermost surface of the data carrier will not interfere with the first security feature as said first security feature is a so called interfacial feature at the interface between at least some of the layers of the data carrier. The second security features can notably be a latent image, an embossing, a debossing, a diffractive feature, a watermark and so on. Advantageously, the second security feature is obtained by laser engraving. The laser engraving of the data carrier according to the invention allows forming a second security feature with high level of complexity and reliability while not interfering with the first security feature.

[0085] The second security feature can also be an interfacial feature obtained according to the same process as for the first security feature.

[0086] Preferably, the second security feature is at least partially overlapping the first security feature along the extension direction (E).

[0087] Advantageously, the data carrier comprises a see-through portion or a window. In this case, the different layers of the data carrier are preferably at least partially translucent at the region of the see-through portion.

[0088] Preferably, said see-through portion is at least partially overlapping the first security feature along the extension direction (E). This overlapping allows forming particularly complex design which would be very difficult for a forger to reproduce and/or to selectively alter.

[0089] The interaction between the see-through portion and the first security feature involves the strategic placement of the first deformation and/or the replicated deformation in alignment with the see-through portion. This configuration allows enhancing the security of the document by combining different security feature elements in a way that is challenging to replicate or counterfeit. By integrating interfacial security feature with the formation of a see-through portion, the data carrier achieves a multilayered security approach. This makes it even more difficult for counterfeiters to reproduce all the security elements accurately.

[0090] The see-through portion can be produced by forming a void in one or more layers of the data carrier, allowing visibility through the data carrier. The void can be formed by punching or cutting away some material from one or more layers of the data carrier. In the context of the invention, the see-through portion allows viewing at least part of the deformation and/or the replicated deformation of the security feature.

[0091] In the described embodiment, the see-through portion is part of a multilayered structure involving clear and white polycarbonate layers, with the clear layer potentially having embossed security features. This combination of a see-though portion and embossed elements contributes to the document's security and makes it more resistant to counterfeiting.

[0092] The first security feature of the data carrier can be overt and visible for bare eyes. On the other hand, the marking may be covert and require use of a magnification such as a loupe, a microscope and/or different lighting conditions in order to be visible. In the same way, the second security feature of the data carrier can be overt or covert.

[0093] Advantageously, the data carrier comprises a personalization element. Said personalization element can be formed by many different techniques well known from the state of the art, such as laser engraving. The personalization element can notably comprise a photograph of the holder of a security document comprising the data carrier. Advantageously, said personalization element is at least partially overlapping the first security feature along the extension direction (E). This overlapping allows forming particularly complex design which would be very difficult for a forger to reproduce and/or to selectively alter.

[0094] Preferably, the see-through portion and the personalization element are at least partially overlapping the first security feature along the extension direction (E). This overlapping allows forming an even more complex design which would be particularly difficult for a forger to reproduce and/or to selectively alter.

[0095] According to another aspect, the invention concerns a security document comprising or consisting of at least one data carrier as previously disclosed. The security document is preferably a smart card, an identity card, a passport, a credit card, a bank note or the like.

BRIEF DESCRIPTION OF THE DRAWINGS

[0096] Preferred embodiments of the invention are described in the following with reference to the drawings, which are for the purpose of illustrating the present preferred embodiments of the invention and not for the purpose of limiting the same. In the drawings,

Fig. 1 shows a first step of the method of forming a data carrier according to the invention in a cross section view;

Fig. 2 shows a second step of the method of forming a data carrier according to the invention in a cross section view;

Fig. 3 shows a third step of the method of forming a data carrier according to the invention in a cross section view;

Fig.4 shows another embodiment of a stacked structure formed according to the invention in a cross view;

Fig. 5 shows a top view of a first data carrier according to the invention comprising a first security feature;

Fig. 6 shows a top view of a second data carrier according to the invention comprising a first security feature and a personalization element;

Fig. 7 shows a zoomed top view of the data carrier of figure 6;

Fig. 8 shows another zoomed top view of the data carrier of figure 6;

Fig. 9 shows a top view of a third data carrier according to the invention comprising a first security feature;

Fig. 10 shows a top view of a fourth data carrier according to the invention comprising a first security feature and a personalization element;

DESCRIPTION OF PARTICULAR EMBODIMENTS

[0097] Aspects of the invention shall be further illustrated with reference to the figures.

[0098] Figure 1 depicts a first step of the method of forming a data carrier according to the invention in a cross section view. In this first step, a first outer layer 11, a second outer layer 12 and several inner layers 20 are provided. The number of inner layers 20 can vary depending on the desired properties of the data carrier. One of those inner layers 20 is a so-called core layer 22. This core layer is substantially at the center of the data carrier according to the extension direction (E). Additionally, a revealing layer 30 is provided. Depending on the technique used to form the first deformation of surface, the revealing layer might not be necessary to form the first security feature. The layers represented in these figures are not in scale. The revealing layer is, in most of cases, much thinner than the other layers.

[0099] In the second step as depicted in figure 2, a first deformation 40 of surface of the core layer 22 is formed. This first deformation 40 of surface of the core layer 22 will form a first security feature at the interface between the core layer, the revealing layer and an upper inner layer facing the revealing layer.

[0100] In the third step as depicted in figure 3, a stacked structure is formed with the first outer layer 11, a first inner layer 20, the revealing layer 30, the core layer 22, a second inner layer 20 and the second outer layer 12. This stacked structure is formed by lamination. The parameters of the lamination process will depend on the nature of the layers of the data carrier, on their thickness and so on. During lamination, heat and pressure in applied on the stack of layers, some material of the layers adjacent to the core layer with the first deformation of surface flow and follows the shape of the first deformation. Therefore, during said lamination, the first deformation 40 of the surface of the core layer 22 is replicated such that at least one replicated deformation 42 is formed inside the data carrier at the interface between at least some of the layers. In the embodiment shown in figure 3, a replicated deformation 42 is located at the interface between the core layer 22 and the revealing layer 30 and another replicated deformation 42 is located at the interface between the revealing layer 30 and the above inner layer 20 facing the revealing layer 30. Depending on the intensity of the deformation 40, the height and depth of the resulting recesses and the thickness of the layers, bumps and/or dips, the replicated deformation 42 could be replicated to more adjacent layers. For example, for a stronger deformation with higher intensity, some replicated deformation could be also located at the interface between the upper inner layer 20 and the first outer layer 11.

[0101] Figure 4 is another embodiment of a stacked structure formed according to the method described above. This structure further comprises a see-through portion 70. The first outer layer 11 and second outer layer 12 are opaque layers. This opacity is represented in figure 4 by a hatched pattern. On the contrary, the core layer 22 and the inner layers 20 are translucent or sensibly transparent. This illustration is for explanatory purposes only, it is obviously not excluded that the layers shown without a hatched pattern in the other figures could also be opaque layers. The opaque layers of the stacked structure comprise an opening, advantageously formed before the lamination step. The opaque layers of the stacked structure comprise translucent or sensibly transparent material, such as clear polycarbonate for example, at the area corresponding to the see-through portion. This clear portion of the opaque layers can be formed by removing a part of the opaque material before the lamination step. During lamination, the clear material of adjacent layers flows and fill the void in the opaque layer. In the embodiment shown in figure 4, the clear polycarbonate of inner layers 20 flows during lamination and fill the void in the first outer layer 11 and second outer layer 12. The see through portion is represented by the area 70. At least part of the first security feature 50 overlaps the see through portion 70. In other words, the first security feature 50 is at least partially in alignment with the see-through portion 70.

[0102] Figure 5 depicts a top view of a first data carrier 1 according to the invention comprising a first security feature 50. In this data carrier, the first deformation 40 is formed by pre lamination of a core layer made of polycarbonate. This first deformation is a microtext forming the letters "SETEC". The revealing layer 30 used in this data carrier 1 is a DOVID element. The obtained security feature 50 is an overt security feature or level 1 security feature as it is visible to the naked eye, without need of magnification of specific lightning conditions. The outermost surface of this data carrier 1 remains smooth

and can be subjected to further personalization of subsequent addition of second security feature.

[0103] Figure 6 depicts a top view of a second data carrier 1 according to the invention comprising a first security feature 50 and a personalization element 60. The first deformation 40 is formed by pre lamination of a core layer made of polycarbonate. This first deformation 40 forms guilloches lines. The revealing layer 30 used in this data carrier 1 is a DOVID element. The obtained security feature 50 is an overt security feature or level 1 security feature as it is visible to the naked eye, without need of magnification of specific lightning conditions. This data carrier 1 also comprises a personalized element 60 in the form of a photograph of the face of an end user. This personalized element 60 has been formed by laser engraving. The personalization is subsequent to the formation of the first security feature 50 and the stack of layers forming the data carrier 1.

[0104] Figure 7 is a zoomed top view of the data carrier 1 of figure 6. In this figure, the data carrier 1 is shown with see-through light. This allows a controller to see the guilloches 50 under the personalization 60. The first deformation 40 of surface and the corresponding first security feature 50 remains intact and visible after the lamination process and the personalization process. The combination of the guilloches 50 overlapped with the personalization 60 forms a complex data carrier 1 with high level of security.

[0105] Figure 8 is a further zoomed top view of the data carrier of figure 6, shown with see-through light. The first security feature 50 is shown outside the area with the personalized element 60.This data carrier also comprises a second security feature in the form of microtext forming the letters "SETEC". This second security feature 52 is obtained with the same process as for the first security feature 50. The second security feature 52 is particularly small and involves the need of a magnification to be readable. This second security feature 52 is a covert security feature or level 2 security feature.

[0106] Figure 9 depicts a top view of a third data carrier 1 according to the invention comprising a first security feature 50. In this data carrier, the first deformation 40 is formed by pre lamination of a core layer made of polycarbonate. This first deformation comprises a microtext forming the letters "SETEC" and some pattern lines forming ellipses. The revealing layer 30 used in this data carrier 1 is a silk screen ink comprising metallic pigments. The obtained security feature 50 is both an overt security feature for the pattern and a cover security feature for the microtext.

[0107] Figure 10 shows a top view of a fourth data carrier 1 according to the invention comprising a first security feature 50 and a second security feature 52. In this data carrier, the first deformation 40 is formed by pre lamination of a core layer made of translucent polycarbonate. The revealing layer 30 used in this data carrier 1 is a pearlescent ink layer forming a leaf pattern, said leaf pattern surviving the lamination process and being observable in the obtained data carrier 1. The first deformation 40 forms some guilloche pattern 50. This data carrier 1 also comprises a second security feature 52 in the form of microtext forming the letters "SETEC". This second security feature 52 is obtained with the same process as for the first security feature 50. The second security feature 52 is particularly small and involves the need of a magnification to be readable . This second security feature 52 is a covert security feature or level 2 security feature.

Claims

1. A method of forming a data carrier (1) for a security document (100), the method comprising:

   - providing a first outer layer (11) and a second outer layer (12),
   - forming a first security feature (50) at the interface between at least two adjacent layers, said first security feature (50) comprising a first deformation (40) of surface of one of the layers,
   - forming a stacked structure with said first outer layer (11) and said second outer layer (12), said stacked structure being formed by lamination,

   wherein the first deformation (40) of the surface of one of the layer is replicated during lamination such that at least one replicated deformation (42) is formed inside the data carrier (1) at the interface between at least some of the layers.

2. A method according to claim 1, wherein the data carrier (1) comprises at least one revealing layer (30) facing the first deformation (40) of surface of one of the layers such that the revealing layer (30) is in contact with said first deformation (40) of surface of one of the layers, said revealing layer (30) comprising a replicated deformation (42).

3. A method according to any of the preceding claims, wherein the data carrier comprises at least one inner layer (20), said at least one inner layer (20) comprising the first deformation (40).

4. A method according to any of the preceding claims, wherein it comprises a step of forming a see-through portion (70), said see through portion (70) at least partially overlapping the first security feature (50) along an extension direction (E).

5. A method according to any of the preceding claims, wherein the first deformation (40) of surface of one of the layers is formed by heating said layer, said first deformation (40) of surface of one of the layers being preferably formed by laser cutter, by laser deformation, by pre-lamination, by hot stamping and/or by

welding of said layer.

6. A method according to claims 1 to 4, wherein the first deformation (40) of surface of one of the layers is formed without heating said layer, said first deformation (40) of surface of one of the layers being preferably formed by knife cutter and/or by use of a lacquer or varnish to create an embossing on said layer.

7. A method according to claim 1 to 4, wherein the first deformation (40) of surface of one of the layers is formed by deformation of matter of said layer, said first deformation (40) of surface of one of the layers being preferably formed by laser deformation, by pre-lamination, by hot stamping and/or by welding of said layer.

8. A method according to claim 1 to 4, wherein the first deformation (40) of surface of one of the layers is formed by addition of matter to the surface of said layer, said first deformation (40) of surface of one of the layers being preferably formed by use of a lacquer or varnish to create an embossing on said layer.

9. A method according to claim 1 to 4, wherein the first deformation (40) of surface of one of the layers is formed by removal or ablation of matter of said layer, said first deformation (40) of surface of one of the layers being preferably formed by knife cutter and/or laser cutter.

10. The method according to any of the preceding claims, wherein it comprises a step of forming a personalization element (60), said personalization element (60) preferably at least partially overlapping the first security feature (50) along the extension direction.

11. Data carrier (1) for a security document (100), said data carrier (1) extending along an extension direction (E) and comprising:

- a first outer layer (11) forming a first outer surface of the data carrier (1), and
- a second outer layer (12) forming a second outer surface of the data carrier (1),

said first outer layer (11) and said second outer layer (12) forming a stacked structure,
wherein the data carrier (1) comprises a first security feature (50) at the interface between at least two adjacent layers, said first security feature (50) comprising a first deformation (40) of surface of one of the layers and at least one replicated deformation (42) induced by the first deformation (40).

12. Data carrier (1) according to claim 11, wherein the data carrier comprises at least one revealing layer (30), said revealing layer (30) comprising a replicated deformation (42), and/or
wherein it comprises at least one inner layer (20), said at least one inner layer (20) comprising the first deformation (40).

13. Data carrier (1) according to any of claims 11 to 12, wherein it comprises a see-through portion (70), said see through portion (70) at least partially overlapping the first security feature (50) along an extension direction (E).

14. Data carrier (1) according to claims 11 to 13, wherein the first security feature (50) comprises at least one of an optically variable image, an embossing, a debossing and a watermark-like feature, and/or
wherein the at least one revealing layer (30) comprises offset inks and varnishes, silk screen printing inks and varnishes, DOVID, OVI, pearlescent inks, metallic inks, metallic foils, and/or a colored plastic film.

15. A security document (100) comprising or consisting of at least one data carrier (1) according to any of claims 11 to 14, the security document (100) preferably being a smart card, an identity card, a passport, a credit card, a bank note or the like.

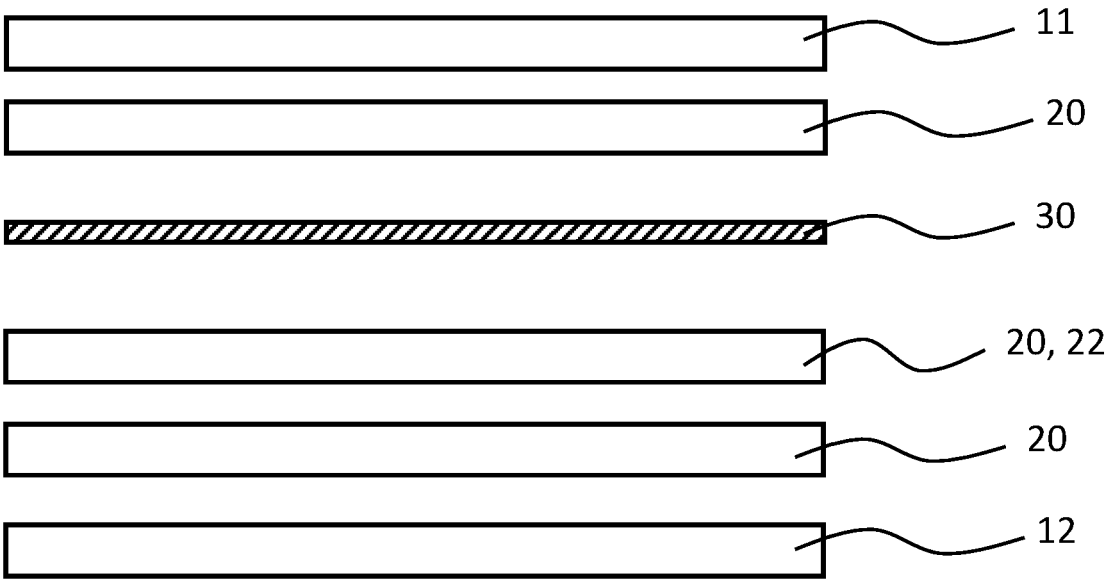

Fig. 1

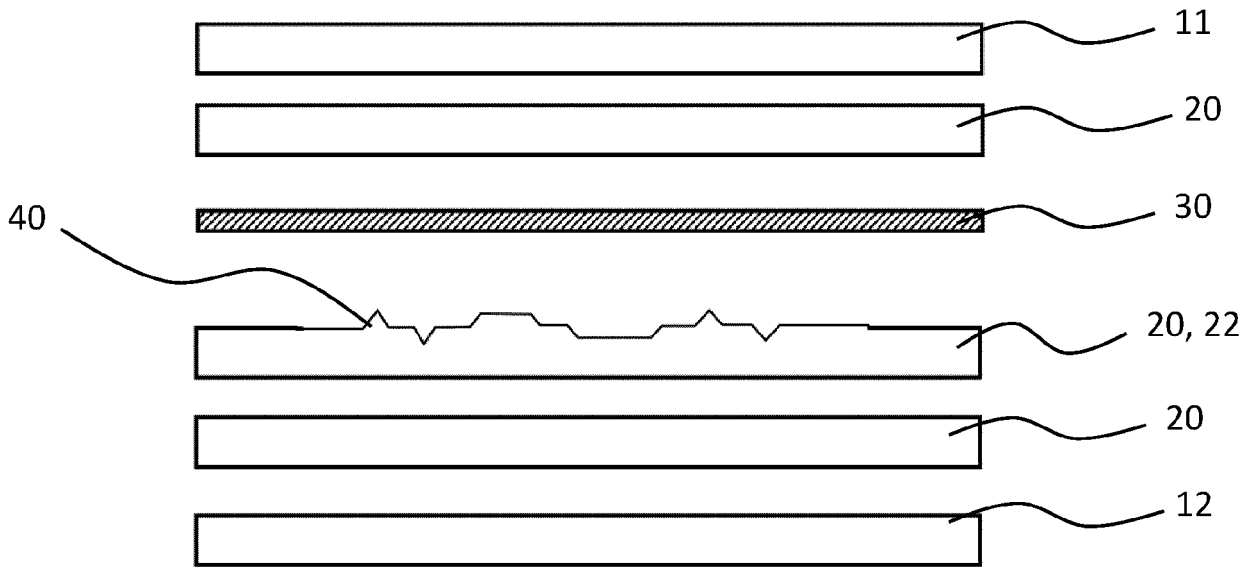

Fig. 2

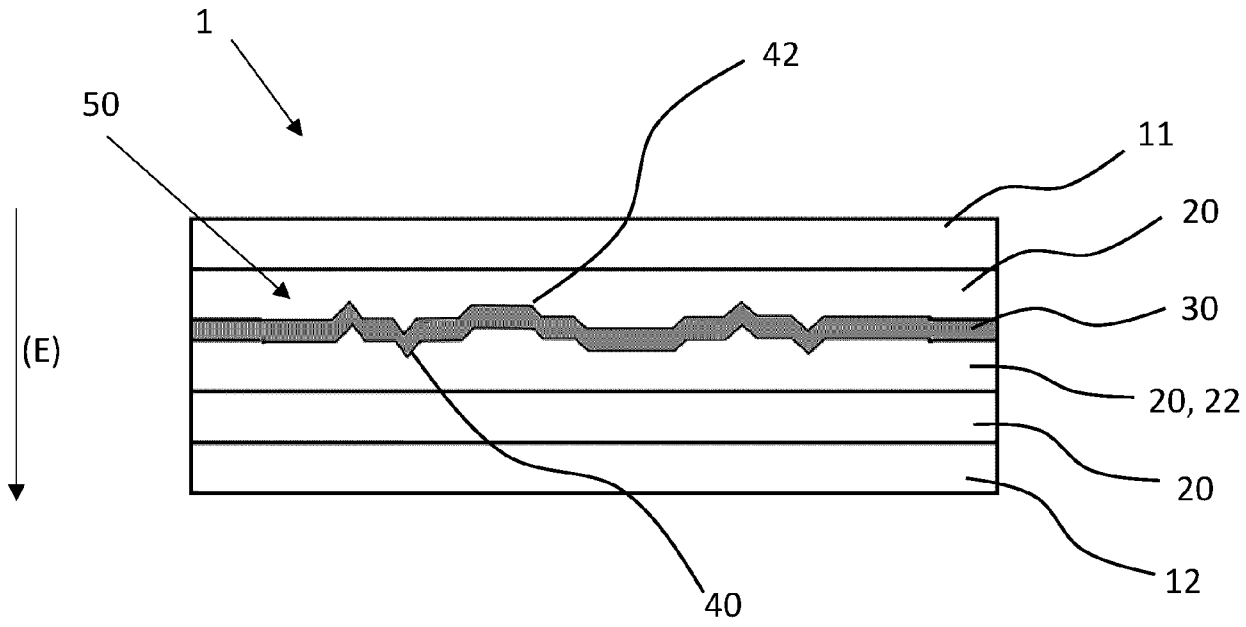

Fig. 3

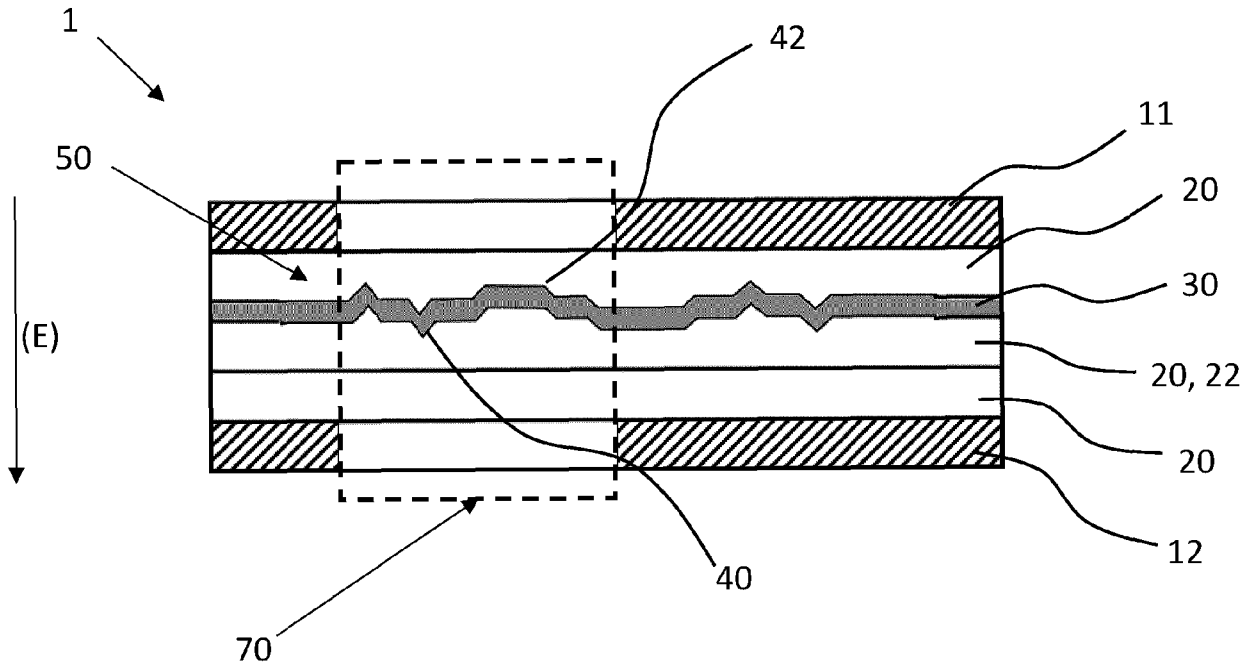

Fig. 4

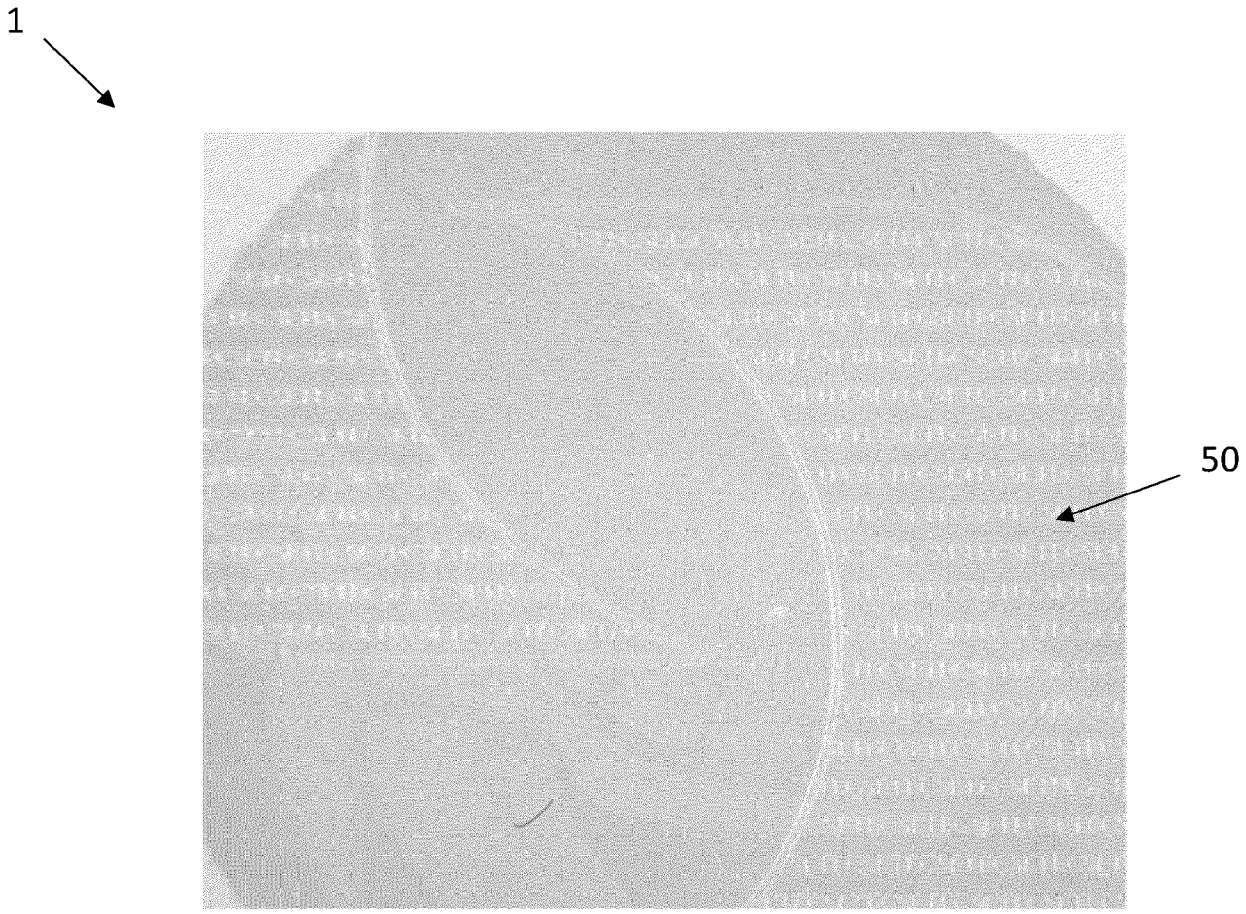

Fig. 5

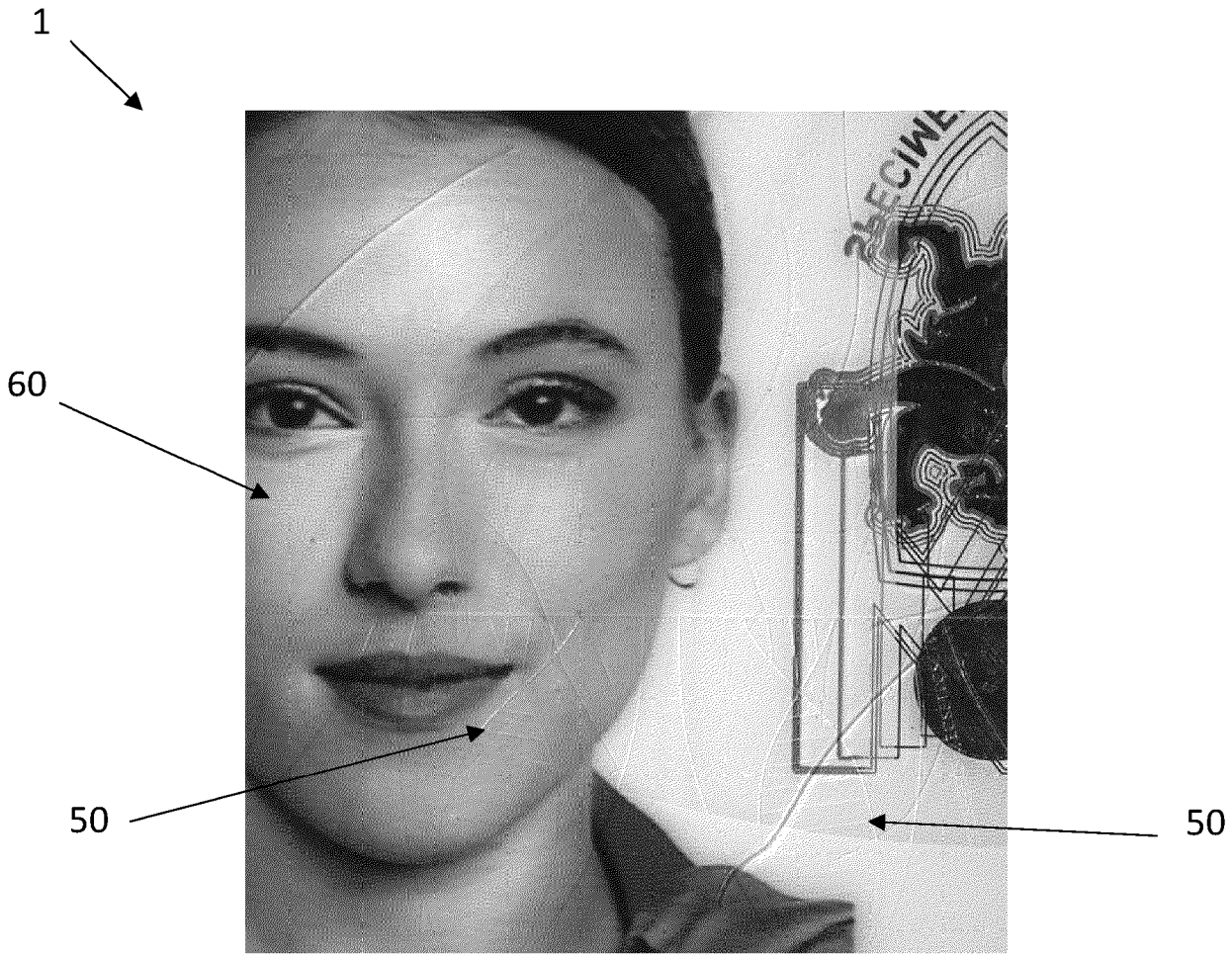

Fig. 6

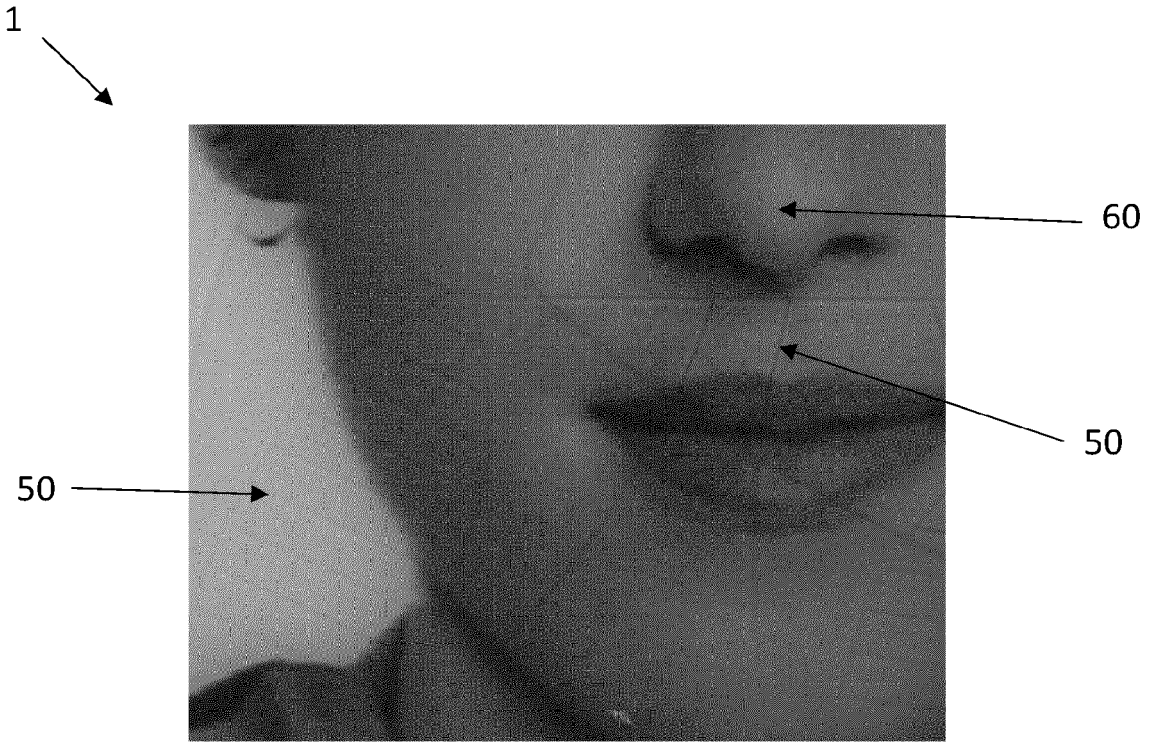

Fig. 7

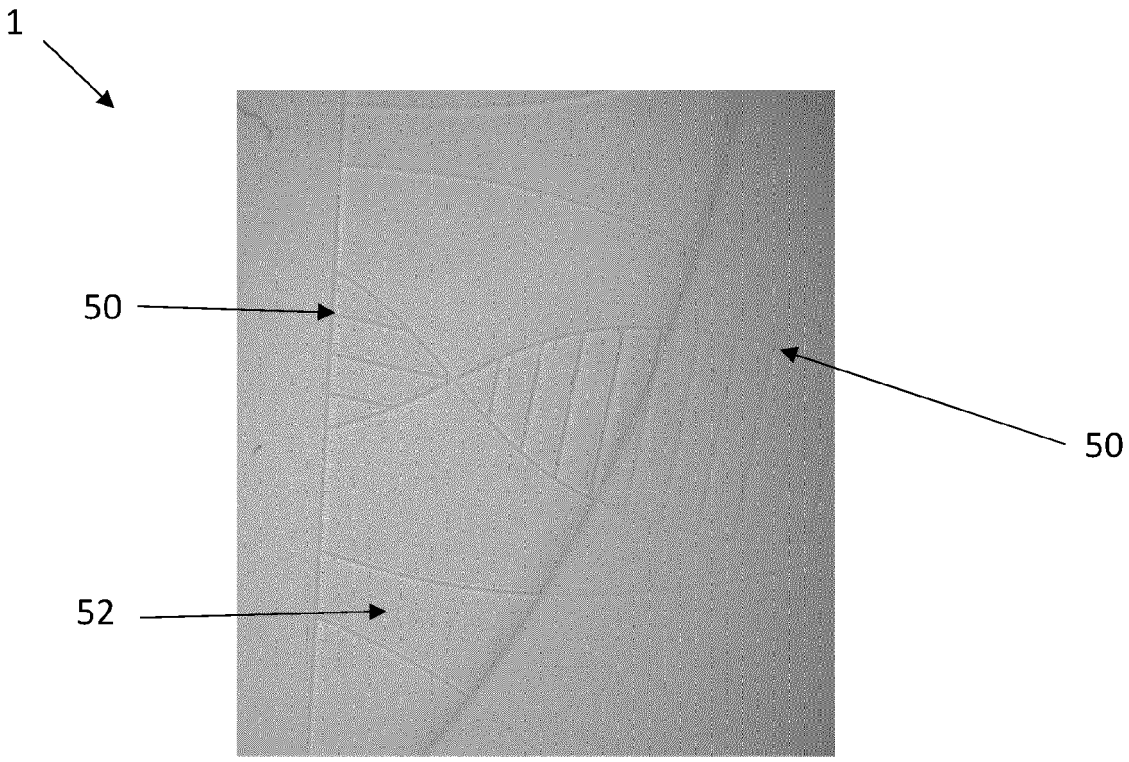

Fig. 8

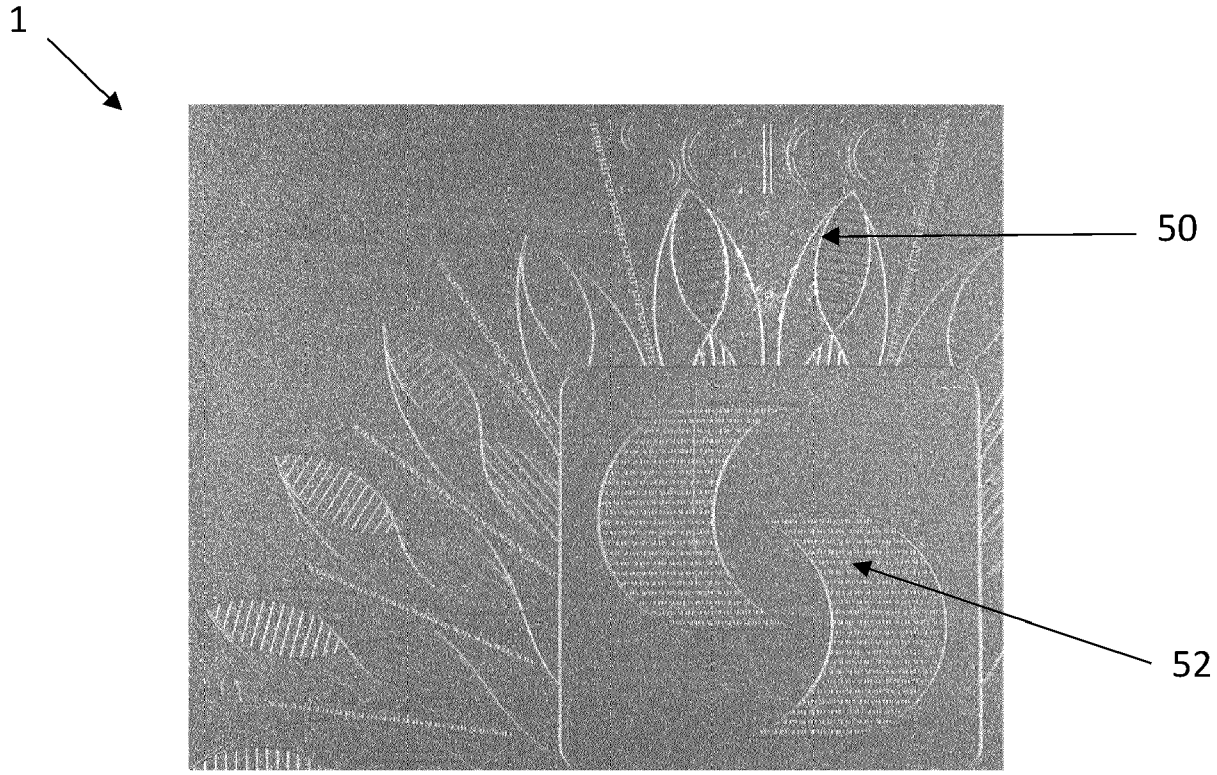

Fig. 9

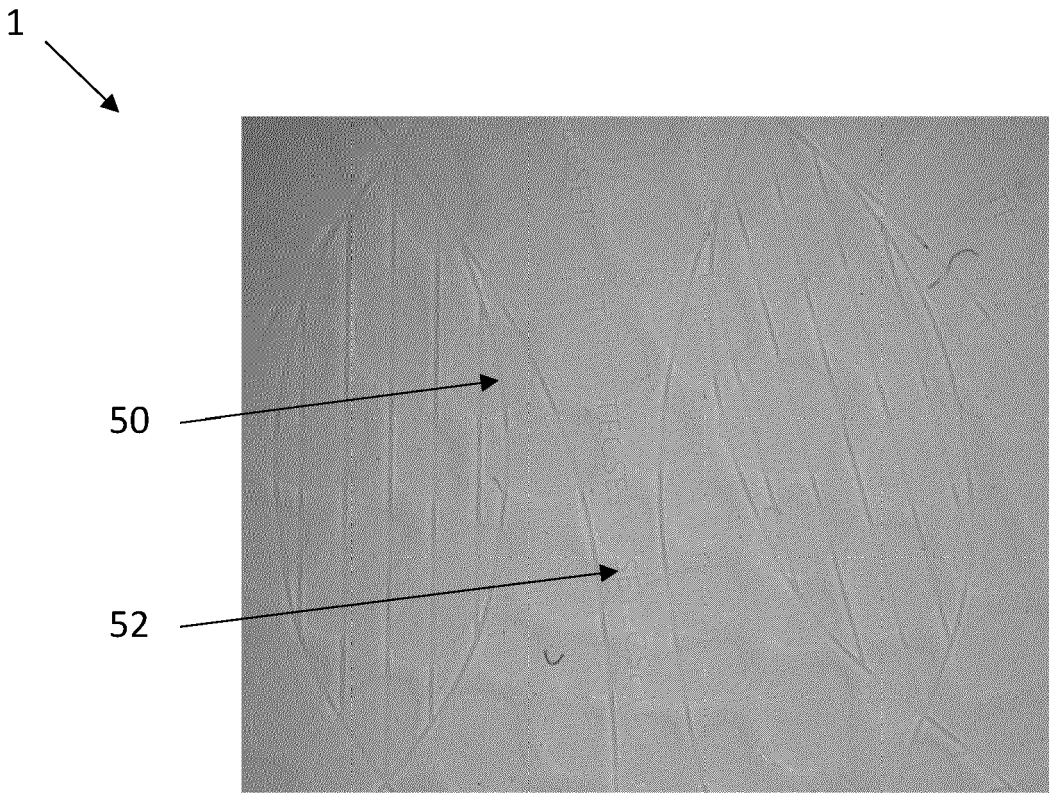

Fig. 10

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Application Number
EP 23 30 7407

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Place of search	Date of completion of the search	Examiner
Munich	13 May 2024	Zacchini, Daniela

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