

### Description:

The object of the invention is a record carrier in card form based on plastic layers with characteristics in the shape of symbols or signs whose dark/light contrast varies in incident and transmitted light, and a process for producing it.

Securities such as banknotes or cheques, and identifying documents such as credit cards, identity cards, cheque cards and the like, must be protected by means of special authenticity characteristics against fraudulent abuse such as counterfeit and corruption. For example, record carriers in card form such as credit cards, identity cards, cheque cards and the like are provided with a transparent covering film which on the one hand prevents the data recorded on the record carrier (text, images, logos, patterns, national emblems and the like) from becoming illegible or unidentifiable as a result of dirt or wear from normal use, and on the other hand ensures in simple fashion and at low cost that the data cannot be altered or corrupted. Particularly in the case of the record carriers in card form which are popular today there is a basic need to protect these to the maximum degree against corruption, reproduction and/or total counterfeit. It should be possible here for any attempted counterfeit to be detected reliably and without any costly testing methods and, as far as possible, by the layman with no need for additional testing means or equipment, so that "genuine" record carriers can be distinguished from forgeries.

Three characteristic requirements are imposed on identity documents and therefore also on record carriers in card form of the type sought in accordance with the invention, i.e.:

1. It must be possible to allocate every identity document to a system in such a way that it can be neither mistaken nor falsified;
2. Every identity document must be a unique entity, and

3. Every identity document must contain incorruptible data specific to its owner.

Allocation to a system is normally carried out by means of specific signs, for example logos, which, where possible, i.e. where there are strict security requirements, are represented by specific authenticity characteristics (for example, watermarks) or specific variations of an authenticity characteristic (for example, watermarks in the form of logos, as in the Eurocheque card).

To make counterfeit difficult or impossible, the information carrier can be secured by various measures employing known techniques used in the printing of securities and banknotes, for example through the use of a record carrier in card form with a card insert consisting of a watermark paper, which may be printed in several colours with so-called guilloches, as is known, for example, in the case of cheque cards. These security or authenticity characteristics, such as the printing of watermarks or guilloches on banknotes, can be produced only by implementing expensive procedures and are therefore very difficult to imitate, although this does not rule out attempted counterfeit in this respect. Furthermore, it is possible to remove the covering film, thus allowing data to be altered.

An identity card is known from DE-PS 29 07 004, consisting of two covering films, of which at least one is transparent, and a card insert made from an opaque material, in particular paper, which is provided with visually identifiable information which is applied by means of a laser beam through the transparent covering film onto the insert. Due to the use of the laser beam, the substrate under the transparent covering film is darkened, and due to the partial destruction of the substrate material corresponding to the recorded information, the possibility of corruption by

removing the covering film can be avoided. However, an identity card of this type has hitherto allowed the use of an additional authenticity characteristic in the form of a watermark only by dint of the fact that a paper printed with a watermark or an insert film provided with a watermark is used as the card insert. A watermark of this type can, however, be corrupted by removing the transparent covering film.

Since the watermark used for securities is regarded in the field of security technology as an authenticity characteristic offering a high level of security, there is a considerable need to provide record carriers in card form of the above-mentioned type also with a watermark comparable to that found on banknotes, but this has hitherto not been successfully achieved in plastic record carriers in card form of the above-mentioned type. In this respect, therefore, no plastic identity cards with "watermarks" are known to date. A "watermark" is understood here to mean a pattern or image, which is virtually unrecognisable when looked at in incident light, but which appears in transmitted light as a clearly visible pattern or image in several grey scales.

As a result of the manufacturing process, such embodiments of authenticity characteristics are identical within the manufacturing tolerances for all the documents of a system, i.e. clear identification of the individual document (as a unique entity) is impossible with authenticity characteristics of a conventional type, such as the watermark. In the case of securities and identity documents, this "unique characteristic" is achieved by means of a continuous numerical coding of the document, which can be forged or altered with comparative ease.

In the case of identity cards which can be manufactured in automated processes, there are known techniques for producing the unique characteristics, making use of the opacity of the substrate or of magnetic patterns present on a magnetic track. The disadvantage of these techniques is that either appropriate manufacturing measures are required or the unique characteristic is produced in a random, i.e. uncontrollable, fashion. Furthermore, these processes are unsuitable for visual verification of authenticity.

An identity card with characteristics which are verifiable in incident light and transmitted light and a process for producing it are known from DE-OS 32 31 460. This identity card consists of at least two adjacent plastic layers of differing transparency, where at least one of these layers is provided with depressions which correspond to the patterns or signs and which are filled to at least part of their depth by the material from the adjacent plastic layer, thus producing the desired dark/light contrast. The disadvantage of this identity card is that this authenticity characteristic must be produced when the blank card mould is manufactured, in the form of the different dark/light contrast in incident or transmitted light, and cannot be designed in the form of data specific to the card or the person, so that the desired security cannot be achieved.

A maximum degree of security against counterfeit and corruption of the data specific to the person held on a record carrier in card form is achieved when the data specific to the person, or at least relevant parts of them, are clearly embedded in the record carrier in the form of authenticity characteristics.

The object of the present invention is therefore to improve a record carrier in card form of the type described above in such a way that the three above-mentioned characteristic security requirements are satisfied, thus ensuring even greater security against counterfeit with simultaneous ease of manufacture and in particular the introduction of characteristic, personalised data in the form of a watermark in record carriers in card form made of plastic.

The object is solved by the characterising features of the record carrier in card form according to the main claim. The subclaims deal with particularly preferred embodiments of the subject matter of this invention and also a process for producing this record carrier.

The invention therefore relates to a record carrier in card form based on plastic layers with characteristics in the shape of symbols or signs whose dark/light contrast varies in incident and transmitted light, characterised by the fact that the record carrier embodies information introduced by a laser beam which modifies the optical properties of the record carrier material, the visual impression produced in incident light being different from that received with transmitted light. The information introduced by means of the laser beam is therefore preferably present in the form of a watermark, of which the visual impression produced in incident light is different from that received with transmitted light.

The watermark as such can also comprise details specific to the card and/or to the person, for example, a card serial number and/or a picture of the holder and/or his signature.

In a preferred embodiment of the invention, the record carrier according to the invention comprises information, introduced by the laser beam, which appears as a single grey tone in transmitted light and as two different grey tones in incident light, so that, for example, in transmitted light only the picture of the card holder is recognisable as a watermark image, onto which additional information is superimposed in incident light, such as a symbol or an inscription, for example the signature of the card owner.

In a further preferred embodiment of the invention, the substrate may consist of coloured plastic and may be provided on one or both sides with a covering film which itself may be coloured. In this case the upper covering, through which the information is recorded onto the substrate whence it can then be visually identified, is transparent, while the rear covering film material is transparent or opaque, i.e. translucent only.

In a further preferred embodiment of the invention, the information imparted by the laser beam takes the form of identical superimposed patterns on at least two different layers of substrate separated by transparent layers. This produces tilting effects, particularly in the case of watermarks whose images are made up of lines, when the card is viewed from different angles.

A further subject matter of the invention involves a process for producing the record carrier in card form described above which consists in using the laser beam to produce in the substrate information which gives a different visual impression when looked at in incident and transmitted light due to the destruction of a light-absorbent and/or reflecting pigment dispersed in the substrate with the formation of reaction products which allow the light to pass through. It is advantageous if the pigment used, which, under the action of the laser beam, produces reaction products enabling the light to pass through, comprises aluminium particles, which are dispersed in polyvinyl chloride as a substrate material. It is advantageous if the aluminium particles are dispersed in the form of very fine aluminium scales, thus giving the record carrier in card form a metallic appearance in the areas where the aluminium is not destroyed nor removed by the effect of the laser beam. Further visual effects can be achieved through the use of coloured covering or substrate films, for example a plastic identity card with a gold effect.

In the process preferred in accordance with the invention, a polyvinyl chloride film filled with aluminium particles is used as a substrate material and is heated under the action of the laser beam used to record the information, with the result that the chain molecules of the polyvinyl chloride disintegrate with the separation of chlorine, which reacts with the metal aluminium according to the following reaction equation:



where R represents the organic part of the polyvinyl chloride chain molecule and R' the part remaining following separation of the chlorine atoms. Whereas the aluminium present in the areas unaffected by the laser beam does not allow light to pass through or reflects it, the aluminium chloride produced in the manner described above is colourless, with the result that the substrate treated with the laser beam in this way allows light to pass through within the effective ranges of the laser beam, thus producing the "watermark effect" referred to above. Whereas the film does not allow light to pass through in the thermally untreated areas due to the aluminium particles, it appears translucent in the areas treated by the laser beam as a result of the optical response of the reaction product.

If the local heating is applied with suitable precision, and this can be done simply by using a controlled laser beam plotter, the above-mentioned chemical reaction can be controlled in such a way that the conversion of the aluminium particles is only partial. This makes it possible to produce a pattern within the identity card which appears as several grey tones in transmitted light and is therefore comparable with the watermark found on banknotes.

In particular, by controlling the intensity of the laser beam plotter using an inverse grey scale table, a photo, for example, or other pictorial image can be introduced in the form of a watermark into the record carrier in card form. In this case, the transparency of the substrate material increases as a result of the above-mentioned chemical process and, when all the aluminium particles are converted to colourless aluminium chloride, reaches the maximum transparency value, which may be specifically set within defined limits on the basis of other characteristics of the film or the special structure of the card.

If the laser beam plotter is used at higher power levels, a further effect is superimposed on this "transparency effect", which is described in summary fashion in DE-OS 30 48 736 and according to which the substrate

material undergoes a change in the areas where it is locally heated by the laser beam (change in colour, altered mechanical stability, increased resistance to chemical agents). It has been found that these processes or chemical reactions either do not occur at all in a pure plastic substrate material such as polyvinyl chloride, or take place only when laser beam power levels are extremely high, in which case, however, the results are explosive and therefore uncontrollable. It has now been discovered that if indestructible pigment particles, for example very fine carbon black particles, are mixed with the substrate material, i.e. polyvinyl chloride, the above-mentioned processes or chemical reactions are triggered even at considerably lower laser beam power levels. Depending on the concentration of these indestructible pigment particles, these processes can be triggered specifically at lower or higher laser beam power levels.

Here the indestructible pigment particles, such as the carbon black particles, absorb radiated energy to a considerably greater degree than the undoped substrate material, such as polyvinyl chloride, and therefore act as agents or catalysts in the above-mentioned process. Due to their small size, the individual particles are invisible to the human eye and have virtually no effect on the transparency of the substrate material because of the low concentration required. Similar, albeit less pronounced effects can be achieved by adding plasticisers to the substrate material.

Furthermore, the recording of the information by means of the laser beam can be specifically influenced through corresponding control of the radiated power, so that, for example, different grey scales can be produced.

It is possible in accordance with the invention, in order to achieve special effects and thus improve the security of the claimed data carrier against counterfeit, to disperse in the substrate material, along with the destructible pigments which produce the transparent reaction product or products, indestructible pigment particles, such as very fine carbon black

particles, which promote the coloration of the substrate material under the action of the laser beam. In this case, the destructible or indestructible pigment particles can be dispersed in the same and/or different substrate layers so as to produce further, virtually counterfeit-proof watermark effects.

The invention is explained below with reference to the enclosed drawings, which can be described as follows:

Fig. 1: an enlarged partial sectional view of an embodiment of the record carrier in card form according to the invention,

Fig. 2: also an enlarged partial sectional view of a further embodiment of the record carrier in card form according to the invention,

Fig. 3: a graph depicting the dependence of the transparency of the substrate material on the intensity of the applied laser beam, and

Figs. 4 and 5: enlarged partial sectional views of further embodiments of the record carrier in card form according to the invention.

As can be seen from fig. 1, the record carrier in card form consists of a substrate 1, for example a polyvinyl chloride film, into which very fine aluminium particles 2 have been introduced during the manufacturing process, evenly distributed throughout its whole volume. In this way, the film appears silvery with a metallic sheen when looked at in incident light and completely dark when looked at in transmitted light. By adding suitable colouring substances, it is possible to create further shiny metallic colour effects.

In the embodiment of the record carrier in card form according to the invention shown in fig. 2, the substrate 1 and the aluminium particles 2 contained within it are enclosed on the front surface by a transparent covering film 3 to protect information introduced using printing techniques, and a covering film 4 on the rear side, which can be

transparent or opaque, for example filled with a white pigment such as titanium dioxide.

Under the action of the laser beam, the aluminium particles 2 shown in figures 1 and 2 react with chlorine atoms which have become separated from the polyvinyl chloride to form aluminium chloride according to the above-mentioned equation, as a result of which the transparency of the substrate material in these areas is increased in transmitted light in the manner already explained above.

The fundamental characteristic property of the substrate according to the present invention, containing light absorbing and/or reflecting pigment which can be destroyed under the action of a laser beam to form transparent reaction products, is explained in more detail with reference to fig. 3. Fig. 3 comprises density curves, which are dependent on the concentration of impurities present at higher (curve B) or lower (curve C) radiation power intensities. The increase in density corresponds in transmitted light to a decrease in transparency. Curve A reveals the response of the substrate material implemented according to the invention under the action of the laser beam. The transparency of the material increases here in proportion to the increase in the intensity of the laser beam, as the aluminium particles are converted according to the above-mentioned equation into aluminium chloride which allows light to pass through. With the laser operating at higher radiation power levels, the aluminium particles act in a similar way to the above-mentioned carbon black particles as agents in the darkening process. As the substrate becomes increasingly coloured (darkened) when higher radiation power levels are used, a simultaneous decrease in transparency occurs, as shown by curve D in fig. 3. As can be seen from this curve D, which involves superposition of curves A and B, transparency increases initially with a suitably doped substrate material as radiated power is increased, due to the chemical reaction of the aluminium particles, and diminishes with a simultaneous increase in the density of the substrate material. The result of this is that a desired

grey value 33 for transparency can be obtained due to two different but no longer totally optional grey scales 34 and 35, to be looked at in incident light. In this way it is possible to create a pictorial image in an area of the card, which, depending on how it is viewed, produces different images in transmitted and incident light, between which a clear mathematical relationship exists in terms of the density and transparency curves. Due to this correlation, which is determined quite specifically by the composition of the substrate material, pairs of pictorial images can be created which cannot be depicted by any other means. It is therefore possible according to the invention, by appropriate selection of the ratio of destructible to indestructible pigment (aluminium particles to carbon black particles) and their particle size and shape, as well as their chemical composition, to produce different density and transparency profiles and therefore a variety of watermarks with different grey tones.

In a simple embodiment of the invention it is possible, for example, in an area which appears in transmitted light as one grey tone, to depict lines or patterns in two different grey tones which appear only when looked at in incident light. It is furthermore possible to display, for example on a pictorial image such as a photograph of the card owner, a symbol, for example a stamp, logo or the like, or an inscription, for example the signature of the card owner, where these additional characteristics are clearly recognisable in incident light but not in transmitted light.

Further variations of these effects can be achieved by combining different films and substrate layers.

If, for example, a transparent film 43 is provided on the rear of the record carrier in card form according to the embodiment of the invention shown in fig. 4, the watermark disappears almost completely when looked at in incident light, whereas if a white film 43 is used, which is filled, for

example, with titanium dioxide, the watermark appears softer in transmitted light but remains clearly recognisable in incident light also.

In the embodiment shown in fig. 4, the record carrier in card form comprises four films, of which the covering film 40 is transparent, the first insert film 41 is doped with aluminium particles, the second insert film 42 is again transparent and the rear covering film 43 is substantially filled with titanium dioxide, i.e. it is white and highly opaque. With this card structure, the image or pattern produced in the film containing the aluminium particles appears as a result of lateral light effects through the layers of the card to be illuminated from within through the transparent inner film.

A further preferred embodiment of the record carrier in card form according to the invention is shown in fig. 5. This record carrier made up of five layers comprises a transparent covering film on the front and rear of the card (50 and 51 respectively) and a transparent intermediate film 52 between the two films 53 and 54 containing aluminium particles. In a card structure of this type tilting effects occur, particularly in the case of watermark images made up of lines, when the card is viewed from different angles.

Beyond the fact that record carriers in card form according to the invention are produced with "watermarks" specific to the card or person, the present invention provides a range of further significant advantages over known watermarks on securities.

- The watermark is imparted to the finished blank identity card mould. This on the one hand simplifies the whole production process and on the other hand removes the need for expensive storage in premises secured against unauthorised access and secure transportation of the blank moulds which have already been provided with authenticity characteristics.

- The watermark can be produced in the same operation as the other data with which the card is provided.

- The flexibility of available laser beam plotters allows the watermark to be changed from one card to the next so that is possible to design every identity card in the form of a unique entity, for example by using a serial number in the form of a watermark (data specific to the card).

- The creation of the watermark at the same time as the recording of the other personalised data, combined with the flexibility of the laser beam plotter enables the formation of a personalised watermark, for example in the form of the signature or a picture of the card owner, and therefore the incorruptible incorporation of personal data into the authenticity characteristic.

By these means, the object described above can be solved in very simple and elegant fashion to provide a record carrier in card form whose authenticity can easily be recognised even by the "man in the street".

**Patent Claims**



1. A record carrier in card form based on plastic layers with characteristics in the shape of symbols or signs whose dark/light contrast varies in incident and transmitted light

**characterized by the fact that**

the record carrier embodies information introduced by a laser beam which modifies the optical properties of the record carrier material by means of a coloured pigment pattern in the carrier substrate, the visual impression produced in incident light being different from that received with transmitted light.

2. Record carrier in accordance with Claim 1 characterized by the fact that the information introduced by the laser beam comprises details specific to the card and/or person.
3. Record carrier in accordance with Claim 1 or 2 characterized by the fact that the information introduced by the laser beam takes the form of a watermark.
4. Record carrier in accordance with Claim 3 characterized by the fact that the information occurring in the form of a watermark conveys additional information which appears as differing grey tones in incident light.



5. Record carrier in accordance with Claim 4 characterized by the fact that the information introduced by the laser beam appears as a single grey tone in transmitted light and as two different grey tones in incident light.
6. Record carrier in accordance with Claim 4 or 5 characterized by the fact that the information occurring in the form of a watermark comprises a pictorial image apparent only in transmitted light which, as additional information, carries a symbol or an inscription which is clearly identifiable in incident but not in transmitted light.
7. Record carrier in accordance with at least one of the preceding claims characterized by the fact that the substrate may consist of coloured plastic and be provided on one or both sides with possibly coloured covering films and that the information is imparted to the substrate by the laser beam acting through the transparent covering film.
8. Record carrier in accordance with Claim 7 characterized by the fact that the upper covering film is transparent and the rear covering film is transparent or opaque.
9. Record carrier in accordance with at least one of the preceding claims characterized by the fact that the information introduced by the laser beam takes the form of identical superimposed patterns on at least two different layers of substrate separated by transparent layers.



10. Process for producing the record carrier in accordance with Claims 1 to 9 characterized by the fact that the laser beam is used to produce in the substrate information which gives a different visual impression when looked at in incident and transmitted light due to the destruction of a light-absorbent and/or reflecting pigment dispersed in the substrate with the formation of reaction products allowing the light to pass through.
11. Process in accordance with Claim 10 characterized by the fact that the pigment used to produce reaction products enabling the light to pass through comprises aluminium particles, and the substrate material used is polyvinyl chloride.
12. Process in accordance with Claim 10 characterized by the fact that the substrate, in addition to the destructible pigment producing reaction products transparent to light, contains dispersed indestructible pigment particles which promote the coloration of the substrate material under the action of the laser beam.
13. Process in accordance with Claim 12 characterized by the fact that the indestructible pigment particles take the form of very fine particles of carbon black dispersed in the substrate material.
14. Process in accordance with Claim 12 or 13 characterized by the fact that the indestructible pigment particles are dispersed in the substrate material in a particle size and quantity such that the transparency of the substrate is not impaired.



15. **Process in accordance with the Claims 12 to 14 characterized by the fact that the destructible and indestructible pigment particles are dispersed in the same and/or different substrate layers.**