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(54) **MULTILAYER BODY OPTICAL ANTI-COUNTERFEITING ELEMENT AND FABRICATION METHOD THEREFOR**

(57) The disclosure provides an optical anti-counterfeiting element and a manufacturing method therefor. The optical anti-counterfeiting element includes a relief structure layer (2), which includes a first region (A) having a first microstructure and a second region (B) having a second microstructure, a specific volume of the second microstructure is greater than a specific volume of the first microstructure; and a first coating (31), a dielectric layer (32), a second coating (33) and a protective layer (4) stacked in sequence on a side of the relief structure layer (2), wherein the first coating (31) and the dielectric layer (32) are located in the first region (A) and the second region (B), the second coating (33) and the protective layer (4) are located in the first region (A) but not located in the second region (B), and the first coating (31), the dielectric layer (32) and the second coating (33) form a functional coating group (3), the functional coating group (3) and the first microstructure have a combined optical characteristic in the first region (A), and the first coating (31) and the second microstructure have a combined optical characteristic in the second region (B).

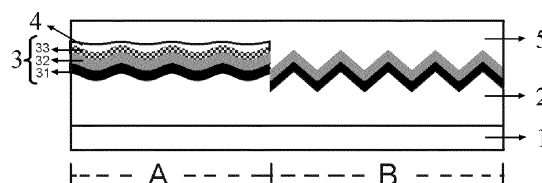


Fig. 2

Description**Technical Field**

5 **[0001]** The disclosure relates to the technical field of optical anti-counterfeiting technology, and in particular to an optical anti-counterfeiting element and a manufacturing method for an optical anti-counterfeiting element.

Background

10 **[0002]** In order to prevent counterfeits produced by scanning and copying, the optical anti-counterfeiting technology is widely used in various high safety or high value-added printed materials such as banknotes, credit cards, passports, securities and product packaging, and has achieved extremely excellent effects.

[0003] In various optical anti-counterfeiting technologies, optical effects forming by the microstructure include diffraction, non-diffraction, etc., which is widely used by high brightness and obvious dynamic effect. The microstructure optical anti-counterfeiting technology generally uses a metal reflecting layer, for example aluminum, so as to increase the brightness of the image. Wherein, the holographic technology, the most widely used optical anti-counterfeiting technology in optical films at present, is developed by utilizing the diffraction effect formed by the microstructure, and has been used in anti-counterfeiting lines of 5 yuan, 10 yuan, 20 yuan, 50 yuan and 100 yuan in the fifth set of 1999 edition of RMB. In addition, the multilayer functional coating group technology has strong optical discoloration effect under different observation angles, or obvious discoloration effect under reflection and transmission observation, thereby drawing increasing attention from people, and is generally known as the multilayer interference optical variation technology. The classical multilayer interference coating generally uses the sandwich type Fabry-Perot interference cavity structure formed by a reflecting layer, a dielectric layer and an absorbing layer. The reflecting layer is generally made of high-brightness metal materials, the dielectric layer is generally made of transparent inorganic or organic materials, and the absorbing layer, also known as a semitransparent layer, is generally made of thin metal materials having excellent absorption. The security line of 100 yuan in the fifth set of 2015 edition of RMB uses the multilayer interference optical variation technology, which is magenta under front observation and green under inclined observation.

[0004] If the characteristics of the optical microstructure, the high-brightness metal reflecting layer and the multilayer functional coating group are integrated into the same optical anti-counterfeiting element, the optical anti-counterfeiting effect will be greatly enhanced. Patent application CN 200980104829.3 provided the preparation of the optical anti-counterfeiting product integrating the multilayer interference optically variable coating and the high-brightness metal reflecting layer by means of a local printing and hollowing process, that is, some regions have multilayer interference optically variable characteristics, some regions have optical characteristics of the high-brightness metal reflecting layer, and further, the other regions have the perspective hollow effect. However, the mutual alignment accuracy of the three regions in the patent application depends on the printing accuracy, which is generally above 100 μ m, resulting in limitations on the application in high-end anti-counterfeiting optical products to a certain extent.

[0005] Therefore, it is of great significance to manufacture optical anti-counterfeiting elements having characteristics of high-brightness metal reflecting layer and multilayer interference optically variable characteristics and having zero positioning error between two characteristic regions. Further, if the optical anti-counterfeiting element further integrates the hollow characteristic, and the hollow region and the image region are also positioned with zero error, the anti-counterfeiting performance of the product will be further improved.

Summary

45 **[0006]** The objective of the disclosure is to provide a multilayer body optical anti-counterfeiting element and a manufacturing method therefor. During observation from a first side and/or a second side of the optical anti-counterfeiting element, the optical anti-counterfeiting element has a characteristic of a high-brightness metal reflecting layer and a characteristic of a multilayer functional coating group (especially an interference optically variable coating) at the same time, such that a product having the optical anti-counterfeiting element has excellent comprehensive integrated anti-counterfeiting performance. Further, if the optical anti-counterfeiting element further integrates a hollow characteristic, and a hollow region and an image region are positioned with zero error, the anti-counterfeiting performance of the product may be further improved.

[0007] In order to achieve the above objective, an embodiment of the disclosure provides an optical anti-counterfeiting element. Structurally, the optical anti-counterfeiting element includes a substrate, a first side of the substrate has a relief structure layer, the relief structure layer includes a first region having a first microstructure and a second region having a second microstructure, a specific volume of the second microstructure is greater than a specific volume of the first microstructure; a first coating, a dielectric layer, a second coating and a protective layer stacked in sequence are arranged on a side of the relief structure layer; the first coating and the dielectric layer are located in the first region and the second

region, and the second coating and the protective layer are located in the first region but not located in the second region; and the first coating, the dielectric layer and the second coating form a functional coating group, the functional coating group and the first microstructure have a combined optical characteristic in the first region, and the first coating and the second microstructure have a combined optical characteristic in the second region. Since the two image regions (the first region and the second region) presented by reflection observation are determined by the microstructure, thereby having a zero positioning error characteristic.

[0008] A specific volume of a relief structure mentioned herein refers to a ratio of an assumed liquid volume of just completely covering a surface of the relief structure to a projection area of the relief structure on the horizontal plane under the condition that the relief structure is placed in a horizontal state; the disclosure further relates to another important physical quantity, i.e. a depth-to-width ratio of the relief structure, which refers to a ratio of a depth of the relief structure to a width (or a period of a periodic structure) of the relief structure; according to this definition, the depth-to-width ratio is a dimensionless physical quantity, and a dimension of the specific volume is $\mu\text{m}^3/\mu\text{m}^2$; according to this definition, a flat structure is regarded as the relief structure having zero depth-to-width ratio and zero specific volume; the depth-to-width ratio and the specific volume are two physical quantities which have no direct relation in quantity; for example, if a structure A is a one-dimensional sawtooth grating having a depth of $1\mu\text{m}$ and a period of $1\mu\text{m}$, a depth-to-width ratio of the structure A is 1, and a specific volume of the structure A is $0.5\mu\text{m}^3/\mu\text{m}^2$; if a structure B is a one-dimensional sawtooth grating having a depth of $2\mu\text{m}$ and a period of $4\mu\text{m}$, a depth-to-width ratio of the structure B is 0.5, and a specific volume of structure B is $1\mu\text{m}^3/\mu\text{m}^2$; that is, the depth-to-width ratio of the structure A is greater than the depth-to-width ratio of the structure B, and the specific volume of the structure B is greater than the specific volume of the structure A; a difference of the specific volumes of the first microstructure and the second microstructure is a basis for removing a second coating in the second region; and a coating on a particular microstructure is accurately removed on the basis of the difference of the specific volume, which will be further described in the Detailed Description of the Embodiments.

[0009] Generally, the first microstructure or the second microstructure is a periodic structure or one structure or a combined structure in the periodic structure; and a cross-sectional structure of the first microstructure or the second microstructure is any one structure or a combined structure formed by at least any two structures of a sinusoidal structure, a rectangular grating structure, a trapezoidal grating structure, a blazed grating structure and an arc-shaped grating structure.

[0010] In an implementation mode, the specific volume of the first microstructure is greater than or equal to $0\mu\text{m}^3/\mu\text{m}^2$ and less than $0.5\mu\text{m}^3/\mu\text{m}^2$; and the specific volume of the second microstructure is greater than $0.4\mu\text{m}^3/\mu\text{m}^2$ and less than $3\mu\text{m}^3/\mu\text{m}^2$.

[0011] In an implementation mode, the first coating is adjacently connected to the relief structure layer.

[0012] In an implementation mode, a material of the first coating or the second coating is any one metal or an alloy formed by combining at least any two metals of nickel, chromium, aluminum, silver, copper, tin and titanium; and a material of the dielectric layer is any one compound or a mixture formed by at least any two compounds of magnesium fluoride, silicon dioxide, zinc sulfide, titanium nitride, titanium dioxide, titanium monoxide, titanium sesquioxide, trititanium pentoxide, tantalum pentoxide, niobium pentoxide, cerium dioxide, bismuth trioxide, chromium oxide green, iron oxide, hafnium oxide and zinc oxide.

[0013] In an implementation mode, the functional coating group is a multilayer interference optically variable coating, and the optical anti-counterfeiting element on any side of the multilayer interference optically variable coating has an interference optically variable characteristic.

[0014] Further, in order to make the product capable of having an accurate positioning hollow characteristic, the relief structure layer further includes a third region having a third microstructure, a depth-to-width ratio of the third microstructure is greater than a depth-to-width ratio of the second microstructure, and a specific volume of the third microstructure is greater than a specific volume of the first microstructure; the first coating and the second coating are not located in the third region; and the optical anti-counterfeiting element has a hollow characteristic in the third region. A difference of the specific volumes of the third microstructure and the first microstructure and a difference of a depth-to-width ratios of the third microstructure and the second microstructure are a basis for removing both of the first coating and the second coating in the third region. A coating on a particular microstructure is accurately removed on the basis of the difference of the depth-to-width ratio, which will be further described in the Detailed Description of the Embodiments. In an implementation mode, the depth-to-width ratio of the third microstructure is greater than 0.2 and less than 1; the depth-to-width ratio of the second microstructure is greater than 0 and less than 0.3; and the specific volume of third microstructure is greater than $0.4\mu\text{m}^3/\mu\text{m}^2$ and less than $3\mu\text{m}^3/\mu\text{m}^2$.

[0015] An embodiment of the disclosure further provides a manufacturing method for an optical anti-counterfeiting element. The manufacturing method includes:

S1), forming a relief structure layer, wherein the relief structure layer includes a first region having a first microstructure and a second region having a second microstructure, a specific volume of the second microstructure is greater than

a specific volume of the first microstructure;

S2), forming a first coating, a dielectric layer, a second coating and a protective layer stacked in sequence on a side of the relief structure layer; and

S3), placing a semi-finished product in S2) into an atmosphere capable of reacting with the second coating until part or all of the second coating located in the second region is removed, and at least reserving a first coating and a second coating which are stacked only in the first region, where the first coating and the second coating are non-removed part of the first coating and non-removed part of the second coating which are located in the first region respectively.

[0016] In an implementation mode, the relief structure layer in S1) further includes a third region having a third microstructure, a depth-to-width ratio of the third microstructure is greater than a depth-to-width ratio of the second microstructure, and a specific volume of the third microstructure is greater than a specific volume of the first microstructure.

[0017] In an implementation mode, the manufacturing method further includes: S4) placing a semi-finished product in S3) into an atmosphere capable of reacting with the first coating until part or all of the first coating and the second coating which are located in the third region are removed.

[0018] In an implementation mode, the first coating or the second coating in S3) includes an aluminum layer, or the first coating and the second coating in S3) include an aluminum layer; and

an acid liquor or an alkali liquor is selected as the atmosphere capable of reacting with the second coating in S3); an acid liquor or an alkali liquor is selected as the atmosphere capable of reacting with the first coating in S4).

[0019] In an implementation mode, the manufacturing method further includes: applying an inorganic or organic coating or a painting layer process to achieve other optical anti-counterfeiting functions or auxiliary functions.

[0020] Other features and advantages of the embodiment of the disclosure will be described in detail in the Brief Description of the Drawings that follows.

Brief Description of the Drawings

[0021] The drawings, which are used for providing further understanding of the embodiment of the disclosure and constitute a part of the description, together with the following particular implementation, serve to explain the embodiment of the disclosure instead of limiting same. In the drawings:

Fig. 1 shows a top view of a first exemplary optical anti-counterfeiting element of the embodiment of the disclosure;

Fig. 2 shows a possible cross-sectional view of the first exemplary optical anti-counterfeiting element in an X-X direction of the embodiment of the disclosure;

Fig. 3 shows a cutaway view of an exemplary element after formation of a relief structure layer in a process of manufacturing the first exemplary optical anti-counterfeiting element of the embodiment of the disclosure;

Fig. 4 shows a cutaway view of the exemplary element after formation of a functional coating group in the process of manufacturing the first exemplary optical anti-counterfeiting element of the embodiment of the disclosure;

Fig. 5 shows a cutaway view of the exemplary element after formation of a protective layer in the process of manufacturing the first exemplary optical anti-counterfeiting element of the embodiment of the disclosure;

Fig. 6 shows a cutaway view of the exemplary element after a corrosion atmosphere in the process of manufacturing the first exemplary optical anti-counterfeiting element of the embodiment of the disclosure;

Fig. 7 shows a top view of a second exemplary optical anti-counterfeiting element of the embodiment of the disclosure;

Fig. 8 shows a possible cross-sectional view of the second exemplary optical anti-counterfeiting element in an X-X direction of the embodiment of the disclosure;

Fig. 9 shows a cutaway view of an exemplary element after formation of a relief structure layer in a process of manufacturing the second exemplary optical anti-counterfeiting element of the embodiment of the disclosure;

Fig. 10 shows a cutaway view of the exemplary element after formation of a functional coating group in the process

of manufacturing the second exemplary optical anti-counterfeiting element of the embodiment of the disclosure;

Fig. 11 shows a cutaway view of the exemplary element after formation of a protective layer in the process of manufacturing the second exemplary optical anti-counterfeiting element of the embodiment of the disclosure; and

Fig. 12 shows a cutaway view of the exemplary element after a corrosion atmosphere in the process of manufacturing the second exemplary optical anti-counterfeiting element of the embodiment of the disclosure.

Description of reference numerals:

- | | | | |
|-----|-----------------------------|-----|----------------------------|
| 1. | a substrate | 2. | a relief structure layer |
| 31. | a first coating | 32. | a dielectric layer |
| 33. | a second coating | 3. | a functional coating group |
| 4. | a protective layer | | |
| 5. | an other functional coating | | |

Detailed Description of the Embodiments

[0022] The particular implementation of the embodiment of the disclosure is described in detail below in conjunction with the drawings. It should be understood that the particular implementation described herein is merely illustrative of the embodiment of the disclosure and is not intended to limit the embodiment of the disclosure.

Embodiment 1

[0023] As shown in Fig. 1, an optical anti-counterfeiting element includes a first region A and a second region B, wherein the first region A has a combined optical characteristic of a first optical microstructure and a functional coating group, and the second region B has a combined optical characteristic of a second optical microstructure and a first coating. The two regions are strictly positioned to each other. Partial lines of an image may be very fine. For example, the partial lines are less than 50 μ m. In an embodiment, the functional coating group is a multilayer interference optically variable coating, and a first coating is a metal reflection coating (e.g. an aluminum layer), such that the first region A appears an interference optically variable characteristic and the second region B appears a characteristic of the common metal reflection coating.

[0024] As shown in Fig. 2, the optical anti-counterfeiting element includes a substrate 1, a relief structure layer 2, a first coating 31, a dielectric layer 32, a second coating 33, a protective layer 4 and an other functional coating 5, wherein the first coating 31, the dielectric layer 32 and the second coating 33 form a functional coating group 3; the substrate 1 and the relief structure layer 2 is usually composed of a transparent material; the relief structure layer 2 includes the first region A composed of a first microstructure and the second region B composed of a second microstructure, a specific volume of the second microstructure is greater than a specific volume of the first microstructure; the functional coating group 3 composed of the first coating 31, the dielectric layer 32 and the second coating 33 is arranged on the first region A, and the first coating 31 and the dielectric layer 32 are arranged on the second region B. Usually, the dielectric layer 32 is a colorless transparent material and does not provide special optical effects in the second region B. During observation from above and/or below the anti-counterfeiting element, the first region A appears a combined optical characteristic of the first microstructure and the functional coating group 3, and the second region B appears a combined optical characteristic of the second microstructure and the first coating 31. If the first coating 31 is semitransparent and the second coating 33 is non-transparent or substantially non-transparent, the optical anti-counterfeiting element must be observed from below; if the first coating 31 is non-transparent or substantially non-transparent and the second coating 33 is semitransparent, the optical anti-counterfeiting element must be observed from above; and if both the first coating 31 and the second coating 33 are semitransparent, the optical anti-counterfeiting element may be observed both from below or above. The functional coating group 3 is adjacently connected to a protective layer 4. The protective layer 4 is a natural product in a manufacturing process and generally does not provide additional optical effects. Particularly, in the first region A, the first coating 31, the dielectric layer 32 and the second coating 33 are used as a reflecting layer, a dielectric layer and an absorbing layer respectively and are combined to form a multilayer interference optically variable coating, that is, the first region A has a combined anti-counterfeiting characteristic of the first microstructure and the multilayer interference optically variable coating; and the second region B has a combined anti-counterfeiting characteristic of the second microstructure and a traditional reflecting layer. The other functional coating 5 may be provided as required, such as a bonding layer that has a function of bonding a protected main product.

[0025] A method for preparing an optical anti-counterfeiting element as shown in Fig. 2 according to the disclosure is

described below in conjunction with Figs. 3-6. The method includes S1-S4. For simplicity of description, a multilayer interference optically variable coating is selected as the functional coating group 3, and the first coating 31, the dielectric layer 32 and the second coating 33 are used as a reflecting layer, a dielectric layer and an absorbing layer respectively.

[0026] S1, forming the relief structure layer 2 on a first side of the substrate 1, wherein the relief structure layer 2 at least includes the first region A composed of the first microstructure and the second region B composed of the second microstructure, a specific volume of the second microstructure is greater than a specific volume of the first microstructure, which is as shown in Fig. 3.

[0027] The substrate 1 may be at least locally transparent, or a colorless dielectric layer, or a transparent medium film having a functional coating layer on a surface, or a multilayer film formed through compounding. The substrate 1 is generally formed by a film material having excellent physical and chemical resistance and high mechanical strength, for example, a plastic film of a polyethylene terephthalate (PET) film, a polyethylene terephthalate (PEN) film, a polypropylene (PP) film, etc. may be used to form the substrate 1. In an embodiment, the substrate 1 is formed by the PET material. A bonding enhancement layer may be included on the substrate 1 to enhance bonding of the substrate 1 to the relief structure layer 2. A stripping layer may also be included on the substrate 1 to achieve separation of the substrate 1 in the final product from the relief structure layer 2.

[0028] The relief structure layer 2 may be formed by performing batch copying by means of processing manners of ultraviolet casting, mold pressing, nano-imprinting, etc. For example, the relief structure layer 2 may be formed by a thermoplastic resin by means of a mold pressing process, that is, the thermoplastic resin coating on the substrate 1 in advance is heated to be softened and deformed when passing through a high-temperature metal template, such that a specific relief structure is formed, and then is cooled and molded. The relief structure layer 2 may also be formed by a radiation curing casting process, that is, the substrate 1 is coated with a radiation curing resin, irradiating the substrate 1 by radiation of ultraviolet light, an electron beam, etc. while pushing and pressing a master plate on the substrate 1, so as to cure the above materials, and then the master plate is removed, thereby forming the relief structure layer 2.

[0029] In order to satisfy a requirement of subsequent coating removal, the specific volume of the second microstructure is greater than the specific volume of the first microstructure. In an embodiment, the specific volume of the first microstructure is greater than or equal to $0.1\mu\text{m}^3/\mu\text{m}^2$ and less than $0.5\mu\text{m}^3/\mu\text{m}^2$; and the specific volume of the second microstructure is greater than $0.4\mu\text{m}^3/\mu\text{m}^2$ and less than $3\mu\text{m}^3/\mu\text{m}^2$.

[0030] The first microstructure or the second microstructure is one structure or a combined structure of a periodic structure and a aperiodic structure; and a cross-sectional structure of the first microstructure or the second microstructure is any one structure or a combined structure formed by at least any two structures of a sinusoidal structure, a rectangular grating structure, a trapezoidal grating structure, a blazed grating structure and an arc-shaped grating structure. Size and horizontal arrangement of the first microstructure and the second microstructure are determined by a required optical effect. A flat structure may be selected as the first microstructure.

[0031] S2) forming the functional coating group 3 composed of the first coating 31, the dielectric layer 32 and the second coating 33 on the relief structure layer 2, which is as shown in Fig. 4.

[0032] In the embodiment, the multilayer interference optically variable coating is selected as the functional coating group 3, the first coating 31, the dielectric layer 32 and the second coating 33 are used as the reflecting layer, the dielectric layer and the absorbing layer respectively, that is, the first coating 31 is non-transparent or basically non-transparent, and the second coating 33 is semitransparent.

[0033] The first coating 31 serves as the reflecting layer in the interference optically variable coating. A material of the first coating 31 may be any one metal or a mixture or an alloy of at least any two metals of Al, Cu, Ni, Cr, Ag, Fe, Sn, Au and Pt. A thickness of the first coating 31 is generally selected to be greater than 10nm and less than 80nm, more specifically, greater than 20nm and less than 50nm. If a metal reflection coating is too thin, brightness is not enough; and if the metal reflection coating is too thick, fastness of the metal reflection coating and the relief structure layer 2 is poor, and cost is increased. The first coating 31 may generally be formed on the relief structure layer 2 by means of physical and/or chemical vapor deposition methods, such as, but not limited to, thermal evaporation, magnetron sputtering, metal organic chemical vapor deposition (MOCVD), etc. In an embodiment, the first coating 31 is formed on the relief structure layer 2 in a homomorphic coverage manner with a uniform surface density.

[0034] The dielectric layer 32 provides a function of a dielectric layer in a Fabry-Perot interference cavity. The dielectric layer 32 is generally formed by means of a vapor deposition method, and a material of the dielectric layer may be selected from MgF_2 , Sn, Cr, ZnS, ZnO, TiO_2 , MgO, SiO_2 , or a mixture thereof. After vapor deposition, a surface topography of the dielectric layer 32 and a topography of the first coating 31 are homomorphic or substantially homomorphic. A thickness of the dielectric layer 32 is determined by an effect required by the final interference optically variable coating and is generally greater than 100nm and less than 600nm.

[0035] The second coating 33 serves as the absorbing layer in the interference optically variable coating. The absorbing layer is generally made of a thin metal material, and appears a semitransparent characteristic in light transmission. The second coating 33 may be composed of any one metal or an alloy of at least two metals of aluminum, silver, copper, tin, chromium, nickel and titanium. In an embodiment, aluminum is selected since aluminum has low cost and easy to

remove by an acid liquor or an alkali liquor. The second coating 33 is generally formed by means of a vapor deposition method. After vapor deposition, a surface topography of the second coating 33 and a topography of the first coating 31 and the dielectric layer 32 are homomorphic or substantially homomorphic. A thickness of the second coating 33 is generally greater than 2nm and less than 10nm.

[0036] S3, forming a protective layer 4 on the functional coating group 3, which is as shown in Fig. 5.

[0037] The protective layer 4 is generally formed by means of a printing process. The specific volume of the first microstructure on the relief structure layer 2 is less than the specific volume of the second microstructure, and the functional coating group 3 is generally formed on the relief structure layer 2 in a homomorphic coverage manner, and therefore, a specific volume of a microstructure on a surface of the functional coating group in the first region A is still less than a specific volume of a microstructure on a surface of the functional coating group in the second region B. A proper printing amount of the protective layer 4 may be selected, such that a minimum thickness of the protective layer 4 at the microstructure of the surface of the functional coating group in the first region A is obviously greater than a minimum thickness of the protective layer 4 at the microstructure of the surface of the functional coating group in the second region B. A minimum thickness of the protective layer 4 at the microstructure is generally located at the topmost of the microstructure. Therefore, a protective function of the protective layer 4 for the functional coating group in the first region A is obviously higher than a protective function of the protective layer 4 for the functional coating group in the second region B. Coating weight of the protective layer 4 per unit area is generally required to be greater than 0.1g/m² and less than 1g/m². The smaller viscosity before coating of the protective layer 4, the more beneficial leveling is, and therefore, viscosity of a protective glue solution is generally less than 100cP, more specifically, less than 50cP. A composition of the protective layer 4 may be any one of polyester, polyurethane and acrylic resin, or varnish or ink by combining at least any two thereof as a main resin.

[0038] S4, placing a multilayer structure body in S3 into an atmosphere capable of reacting with the material of the second coating 33 until part or all of the second coating located in the second region B are removed, which is as shown in Fig. 6.

[0039] As mentioned above, the protective function of the protective layer 4 on the functional coating group in the first region A is obviously higher than the protective function of the protective layer 4 on the functional coating group in the second region B. Therefore, within a certain period of time, a corrosion atmosphere will reach and corrode the second coating by means of a vulnerable point of the protective layer in the second region B; and within the time, the protective layer 4 effectively protects the second coating 33 in the first region A. Generally, the dielectric layer 32 does not act with the corrosion atmosphere, that is, the dielectric layer 32 may effectively protect the first coating 31. Thus, the functional coating group 3 accurately located in the first region A and the first coating 31 accurately located in the second region B are acquired. If the second coating 33 is aluminum or a coating including aluminum, the corrosion atmosphere may be an acid liquor or an alkali liquor. Usually, after the second coating on the second region B is corroded, the protective layer on the coating floats along therewith. Sometimes, after the second coating on the second region B is corroded, the protective layer on the coating may partially or even completely remain on the multilayer body, which does not influence implementation of subsequent processes.

[0040] Hereto, a semi-finished product of optical anti-counterfeiting element having the optical characteristic appeared by the functional coating group 3 in the first region A and the optical characteristic appeared by the first coating 31 in the second region B is acquired.

[0041] The method for manufacturing an optical anti-counterfeiting element shown in Fig. 2 generally further includes: after S4, applying the other functional coating 5, such as anti-aging glue, to protect an optical coating, and/or hot melt glue, to bond same to other substrates.

Embodiment 2

[0042] As shown in Fig. 7, an optical anti-counterfeiting element includes a first region A, a second region B and a third region C, wherein the first region A has a combined optical characteristic of a first optical microstructure and a functional coating group, the second region B has a combined optical characteristic of a second optical microstructure and a first coating, and the third region has a hollow characteristic under perspective observation. The third regions are strictly positioned to each other. For example, the third region C shown in Fig. 7 is strictly located at a boundary of the second region B. An image or hollow lines may be very fine frequently. For example, the image or the hollow lines are less than 50μm. In an embodiment, the functional coating group is a multilayer interference optically variable coating, and a first coating is a metal reflection coating (e.g. an aluminum layer), such that the first region A appears an interference optically variable characteristic and the second region B appears a characteristic of the common metal reflection coating.

[0043] As shown in Fig. 8, the optical anti-counterfeiting element includes a substrate 1, a relief structure layer 2, a first coating 31, a dielectric layer 32, a second coating 33, a protective layer 4 and an other functional coating 5, wherein the first coating 31, the dielectric layer 32 and the second coating 33 form a functional coating group 3. The substrate 1 and the relief structure layer 2 is usually composed of a transparent material; the relief structure layer 2 includes a first

region A composed of a first microstructure, a second region B composed of a second microstructure and a third region C composed of a third microstructure, a specific volume of the second microstructure is greater than a specific volume of the first microstructure, a specific volume of the third microstructure is greater than a specific volume of the first microstructure, and a depth-to-width ratio of the third microstructure is greater than a depth-to-width ratio of the second microstructure. The functional coating group 3 composed of the first coating 31, the dielectric layer 32 and the second coating 33 is arranged on the first region A, the first coating 31 and the dielectric layer 32 are arranged on the second region B, and the first coating 31 and the second coating 33 are not arranged on the third region C. Usually, the dielectric layer 32 is a colorless transparent material and does not provide special optical effects in the second region B. During observation from above and/or below the optical anti-counterfeiting element, the first region A appears a combined optical characteristic of the first microstructure and the functional coating group 3, and the second region B appears a combined optical characteristic of the second microstructure and the first coating 31. Since the first coating 31 and the second coating 33 are not arranged, when the optical anti-counterfeiting element is observed through transmission, the first region C has a hollow characteristic. The functional coating group 3 is adjacently connected to a protective layer 4. The protective layer 4 is a natural product in a manufacturing process and generally does not provide additional optical effects. Particularly, in the first region A, the first coating 31, the dielectric layer 32 and the second coating 33 are formed into a multilayer interference optically variable coating as a reflecting layer, a dielectric layer and an absorbing layer respectively, that is, the first region A has a combined anti-counterfeiting characteristic of the first microstructure and the multilayer interference optically variable coating; and the second region B has a combined anti-counterfeiting characteristic of the second microstructure and the common reflecting layer. The other functional coating 5 may be provided as required, such as a bonding layer that has a function of bonding a protected main product.

[0044] A method for preparing an optical anti-counterfeiting element as shown in Fig. 7 according to the disclosure is described below in conjunction with Figs. 9-12. The method includes S1'-S4'. For simplicity of description, a multilayer interference optically variable coating is selected as the functional coating group 3, and the first coating 31, the dielectric layer 32 and the second coating 33 are used as a reflecting layer, a dielectric layer and an absorbing layer respectively.

[0045] S1', forming a relief structure layer 2 on a first side of a substrate 1, wherein the relief structure layer 2 includes the first region A composed of the first microstructure, the second region B composed of the second microstructure and the third region C composed of the third microstructure, a specific volume of the second microstructure is greater than a specific volume of the first microstructure, a specific volume of the third microstructure is greater than a specific volume of the first microstructure, and a depth-to-width ratio of the third microstructure is greater than a depth-to-width ratio of the second microstructure, which is as shown in Fig. 9.

[0046] The substrate 1 may be at least locally transparent, or a colorless dielectric layer, or a transparent medium film having a functional coating layer on a surface, or a multilayer film formed through compounding. The substrate 1 is generally formed by a film material having excellent physical and chemical resistance and high mechanical strength, for example, a plastic film of a polyethylene terephthalate (PET) film, a polyethylene terephthalate (PEN) film, a polypropylene (PP) film, etc. may be used to form the substrate 1. In an embodiment, the substrate 1 is formed by the PET material. A bonding enhancement layer may be included on the substrate 1 to enhance bonding of the substrate 1 to the relief structure layer 2. A stripping layer may also be included on the substrate 1 to achieve separation of the substrate 1 in the final product from the relief structure layer 2.

[0047] The relief structure layer 2 may be formed by performing batch copying by means of processing manners of ultraviolet casting, mold pressing, nano-imprinting, etc. For example, the relief structure layer 2 may be formed by a thermoplastic resin by means of a mold pressing process, that is, the thermoplastic resin coating on the substrate 1 in advance is heated to be softened and deformed when passing through a high-temperature metal template, such that a specific relief structure is formed, and then is cooled and molded. The relief structure layer 2 may also be formed by a radiation curing casting process, that is, the substrate 1 is coated with a radiation curing resin, irradiating the substrate 1 by radiation of ultraviolet light, an electron beam, etc. while pushing and pressing a master plate on the substrate, so as to cure the above materials, and then the master plate is removed, thereby forming the relief structure layer 2.

[0048] In order to satisfy a requirement of subsequent coating removal, the specific volume of the second microstructure is greater than the specific volume of the first microstructure, the specific volume of the third microstructure is greater than the specific volume of the first microstructure, and the depth-to-width ratio of the third microstructure is greater than the depth-to-width ratio of the second microstructure. In an embodiment, the specific volume of the first microstructure is greater than or equal to $0\mu\text{m}^3/\mu\text{m}^2$ and less than $0.5\mu\text{m}^3/\mu\text{m}^2$, the specific volume of the second microstructure is greater than $0.4\mu\text{m}^3/\mu\text{m}^2$ and less than $3\mu\text{m}^3/\mu\text{m}^2$, and the specific volume of third microstructure is greater than $0.4\mu\text{m}^3/\mu\text{m}^2$ and less than $3\mu\text{m}^3/\mu\text{m}^2$; and the depth-to-width ratio of the second microstructure is greater than 0 and less than 0.3, and the depth-to-width ratio of the third microstructure is greater than 0.2 and less than 1. The depth-to-width ratio of the first microstructure is not limited, and may be configured according to a required optical effect.

[0049] The first microstructure, the second microstructure or the third microstructure is one structure or a combined structure of a periodic structure and a periodic structure; and a cross-sectional structure of the first microstructure, the second microstructure or the third microstructure is any one structure or a combined structure formed by at least any

two structures of a sinusoidal structure, a rectangular grating structure, a trapezoidal grating structure, a blazed grating structure and an arc-shaped grating structure. Size and horizontal arrangement of the first microstructure and the second microstructure are determined by a required optical effect. A flat structure may be selected as the first microstructure. The third microstructure is only used for hollowing and generally does not provide additional optical effects, and therefore, may be simplified, such as a blazed grating which is arranged in one dimension and has a cross-sectional of an isosceles triangle having a bottom edge width of $10\mu\text{m}$ and a height of $5\mu\text{m}$ (i.e., a depth-to-width ratio of 0.5 and a specific volume of $2.5\mu\text{m}^3/\mu\text{m}^2$).

[0050] S2', forming the functional coating group 3 composed of the first coating 31, the dielectric layer 32 and the second coating 33 on the relief structure layer 2, which is as shown in Fig. 10.

[0051] In the embodiment, the multilayer interference optically variable coating is selected as the functional coating group 3, the first coating 31, the dielectric layer 32 and the second coating 33 are used as the reflecting layer, the dielectric layer and the absorbing layer respectively, that is, the first coating 31 is non-transparent or basically non-transparent, and the second coating 33 is semitransparent.

[0052] The first coating 31 serves as the reflecting layer in the interference optically variable coating. A material of the first coating 31 may be any one metal or a mixture or an alloy of at least any two metals of Al, Cu, Ni, Cr, Ag, Fe, Sn, Au and Pt. In an embodiment, aluminum is selected since aluminum has low cost and easy to remove by an acid liquor or an alkali liquor. A thickness of the first coating 31 is generally selected to be greater than 10nm and less than 80nm, more specifically, greater than 20nm and less than 50nm. If the metal reflection coating is too thin, brightness is not enough; and if the metal reflection coating is too thick, fastness of the metal reflection coating and the relief structure layer 2 is poor, and cost is increased. The first coating 31 may generally be formed on the relief structure layer 2 by means of physical and/or chemical vapor deposition methods, such as, but not limited to, thermal evaporation, magnetron sputtering, MOCVD, etc. In an embodiment, the first coating 31 is formed on the relief structure layer 2 in a homomorphic coverage manner with a uniform surface density.

[0053] The dielectric layer 32 provides a function of a dielectric layer in a Fabry-Perot interference cavity. The dielectric layer 32 is generally formed by means of a vapor deposition method, and a material of the dielectric layer may be selected from MgF_2 , Sn, Cr, ZnS, ZnO, TiO_2 , MgO, SiO_2 , or a mixture thereof. After vapor deposition, a surface topography of the dielectric layer 32 and a topography of the first coating 31 are homomorphic or substantially homomorphic. A thickness of the dielectric layer 32 is determined by an effect required by the final interference optically variable coating and is generally greater than 100nm and less than 600nm.

[0054] The second coating 33 serves as the absorbing layer in the interference optically variable coating. The absorbing layer is generally made of a thin metal material, and appears a semitransparent characteristic in light transmission. The second coating 33 may be composed of any one metal or an alloy of at least two metals of aluminum, silver, copper, tin, chromium, nickel and titanium. In an embodiment, aluminum is selected since aluminum has low cost and easy to remove by an acid liquor or an alkali liquor. The second coating 33 is generally formed by means of a vapor deposition method. After vapor deposition, a surface topography of the second coating 33 and a topography of the first coating 31 and the dielectric layer 32 are homomorphic or substantially homomorphic. A thickness of the second coating 33 is generally greater than 2nm and less than 10nm.

[0055] S3', forming a protective layer 4 on the functional coating group 3, which is as shown in Fig. 11.

[0056] The protective layer 4 is generally formed by means of a printing process. The specific volume of the first microstructure on the relief structure layer 2 is less than the specific volumes of the second microstructure and the third microstructure, and the functional coating group 3 is generally formed on the relief structure layer 2 in a homomorphic coverage manner, and therefore, a specific volume of a microstructure on a surface of the functional coating group in the first region A is still less than specific volumes of microstructures on a surface of the functional coating group in the second region B and the third region C. A proper printing amount of the protective layer 4 may be selected, such that a minimum thickness of the protective layer 4 at the microstructure of the surface of the functional coating group of the protective layer 4 in the first region A is obviously greater than a minimum thickness of the protective layer 4 at the microstructure of the surface of the functional coating group in the second region B and the third region C. A minimum thickness of the protective layer 4 at the microstructure is generally located at the topmost of the microstructure. Thus, a protective function of the protective layer 4 for the functional coating group 3 in the first region A is obviously higher than a protective function of the protective layer 4 for the functional coating group 3 in the second region B and the third region C. Coating weight of the protective layer 4 per unit area is generally required to be greater than $0.1\text{g}/\text{m}^2$ and less than $1\text{g}/\text{m}^2$. The smaller viscosity before coating of the protective layer 4, the more beneficial leveling is, and therefore, viscosity of a protective glue solution is generally less than 100cP, more specifically, less than 50cP. A composition of the protective layer 4 may be any one of polyester, polyurethane and acrylic resin, or varnish or ink by combining at least any two thereof as a main resin.

[0057] S4', placing a multilayer structure body in S3' into an atmosphere capable of reacting with materials of the first coating 31 and the second coating 33 until part or all of the second coating located in the second region B and the first coating and the second coating located in the third region C are removed, which is as shown in Fig. 12.

[0058] As mentioned above, the protective function of the protective layer 4 on the functional coating group 3 in the first region A is obviously higher than the protective function of the protective layer 4 on the functional coating group 3 in the second region B and the third region C. Therefore, within a certain period of time, a corrosion atmosphere will reach and corrode the second coating 33 by means of a vulnerable point of the protective layer in the second region B and the third region C; and since the depth-to-width ratio of the third microstructure is greater than the depth-to-width ratio of the second microstructure, more cracks are formed in the dielectric layer in the third region than the dielectric layer 32 in the second region B, and therefore, a protective function of the dielectric layer in the third region C on the first coating beneath it is worse than a protective function of the dielectric layer in the second region B on the first coating beneath it. Therefore, in the third region C, after corroding the second coating in the third region, the corrosion atmosphere continues corroding the first coating 31 by means of the vulnerable point of the dielectric layer; and in the second region B, the first coating 31 is effectively protected by the dielectric layer to be reserved. Thus, the functional coating group accurately located in the first region A and the first coating 31 accurately located in the second region B are acquired; and the second coating located in the second region B and the functional coating group 3 located in the third region C are accurately removed. If the first coating 31 and the second coating 33 are aluminum or a coating including aluminum, the corrosion atmosphere may be an acid liquor or an alkali liquor. Usually, after the second coating on the second region B and the third region C is corroded, the protective layer on the coating floats along therewith. Sometimes, after the second coating on the second region B and the third region C is corroded, the protective layer on the coating may partially or even completely remain on a multilayer body, which does not influence implementation of subsequent working procedures.

[0059] Hereto, a semi-finished product of optical anti-counterfeiting element having the optical characteristic appeared by the functional coating group 3 in the first region A, the optical characteristic appeared by the first coating 31 in the second region B, and the hollow characteristic in the third region C is acquired.

[0060] The method for preparing an optical anti-counterfeiting element shown in Fig. 7 generally further includes: after S4', applying the other functional coating 5, such as anti-aging glue, to protect an optical coating, and/or hot melt glue, to bond same to other substrates.

[0061] The method for preparing an optical anti-counterfeiting element according to the disclosure is suitable for manufacturing windowing security lines, labels, marks, wide strips, transparent windows, coating films, etc. Anti-counterfeiting paper having a windowing security line is used for anti-counterfeiting of various high-safety products of banknotes, passports and securities.

[0062] The alternative implementation of the embodiment of the disclosure is described in detail above in conjunction with the drawings. However, the embodiment of the disclosure is not limited to specific details of the above embodiment. Within the scope of the technical concept of the embodiment of the disclosure, various simple modifications may be made to the technical solution of the embodiment of the disclosure, and these simple modifications all fall within the scope of protection of the embodiment of the disclosure.

[0063] It should also be noted that various specific technical characteristics described in the above particular implementation may be combined in any suitable manner, without contradiction. In order to avoid unnecessary repetition, the embodiment of the disclosure will not be described separately for various possible combinations.

[0064] Those skilled in the art may understand that all or part of steps in the methods of the above embodiments may be completed by instructing relevant hardware by means of a program, the program is stored in a storage medium and includes a plurality of instructions for making a single chip computer, a chip or a processor execute all or part of the steps of the methods of the various embodiments of the disclosure. The foregoing storage medium includes a universal serial bus (USB), a mobile hard disk, a read-only memory (ROM), a random access memory (RAM), a diskette or an optical disk, etc., which may store program codes.

[0065] In addition, various different implementations of the embodiment of the disclosure may also be combined randomly, so long as they do not deviate from the idea of the embodiment of the disclosure, and they should also be regarded as disclosed in the embodiment of the disclosure.

Claims

1. An optical anti-counterfeiting element, comprising:

a relief structure layer (2);

the relief structure layer (2) comprises a first region (A) having a first microstructure and a second region (B) having a second microstructure, a specific volume of the second microstructure is greater than a specific volume of the first microstructure;

a first coating (31), a dielectric layer (32), a second coating (33) and a protective layer (4) stacked in sequence are arranged on a side of the relief structure layer (2);

the first coating (31) and the dielectric layer (32) are located in the first region (A) and the second region (B), and the second coating (33) and the protective layer (4) are located in the first region (A) but not located in the second region (B); and

wherein, the first coating (31), the dielectric layer (32) and the second coating (33) form a functional coating group (3), the functional coating group (3) and the first microstructure have a combined optical characteristic in the first region (A), and the first coating (31) and the second microstructure have a combined optical characteristic in the second region (B).

2. The optical anti-counterfeiting element as claimed in claim 1, wherein

the first microstructure or the second microstructure is one structure or a combined structure of a periodic structure and a periodic structure; and

a cross-sectional structure of the first microstructure or the second microstructure is any one structure or a combined structure formed by at least any two structures of a sinusoidal structure, a rectangular grating structure, a trapezoidal grating structure, a blazed grating structure and an arc-shaped grating structure.

3. The optical anti-counterfeiting element as claimed in claim 1, wherein

the specific volume of the first microstructure is greater than or equal to $0\mu\text{m}^3/\mu\text{m}^2$ and less than $0.5\mu\text{m}^3/\mu\text{m}^2$; and the specific volume of the second microstructure is greater than $0.4\mu\text{m}^3/\mu\text{m}^2$ and less than $3\mu\text{m}^3/\mu\text{m}^2$.

4. The optical anti-counterfeiting element as claimed in claim 1, wherein the first coating (31) is adjacently connected to the relief structure layer (2).

5. The optical anti-counterfeiting element as claimed in claim 1, wherein

a material of the first coating (31) or the second coating (33) is any one metal or an alloy formed by combining at least any two metals of nickel, chromium, aluminum, silver, copper, tin and titanium; and

a material of the dielectric layer (32) is any one compound or a mixture formed by at least any two compounds of magnesium fluoride, silicon dioxide, zinc sulfide, titanium nitride, titanium dioxide, titanium monoxide, titanium sesquioxide, trititanium pentoxide, tantalum pentoxide, niobium pentoxide, cerium dioxide, bismuth trioxide, chromium oxide green, iron oxide, hafnium oxide and zinc oxide.

6. The optical anti-counterfeiting element as claimed in claim 1, wherein the functional coating group (3) is a multilayer interference optically variable coating, and the optical anti-counterfeiting element on any side of the multilayer interference optically variable coating has an interference optically variable characteristic.

7. The optical anti-counterfeiting element as claimed in claim 1, wherein

the relief structure layer (2) further comprises a third region (C) having a third microstructure, a depth-to-width ratio of the third microstructure is greater than a depth-to-width ratio of the second microstructure, and a specific volume of the third microstructure is greater than a specific volume of the first microstructure;

the first coating (31) and the second coating (33) are not located in the third region (C); and the optical anti-counterfeiting element has a hollow characteristic in the third region (C).

8. The optical anti-counterfeiting element as claimed in claim 7, wherein

the depth-to-width ratio of the third microstructure is greater than 0.2 and less than 1;

a depth-to-width ratio of the second microstructure is greater than 0 and less than 0.3; and

the specific volume of the third microstructure is greater than $0.4\mu\text{m}^3/\mu\text{m}^2$ and less than $3\mu\text{m}^3/\mu\text{m}^2$.

9. A manufacturing method for an optical anti-counterfeiting element, comprising:

S1) forming a relief structure layer, wherein the relief structure layer comprises a first region having a first microstructure and a second region having a second microstructure, a specific volume of the second microstructure is greater than a specific volume of the first microstructure;

S2) forming a first coating, a dielectric layer, a second coating and a protective layer stacked in sequence on

a side of the relief structure layer; and

S3) placing a semi-finished product in S2) into an atmosphere capable of reacting with the second coating until part or all of the second coating located in the second region is removed, and at least reserving a first coating and a second coating stacked only in the first region, wherein the first coating and the second coating are non-removed parts of the first coating and the second coating which are located in the first region respectively.

10. The manufacturing method for an optical anti-counterfeiting element as claimed in claim 9, wherein the relief structure layer in S1) further comprises a third region having a third microstructure, a depth-to-width ratio of the third microstructure is greater than a depth-to-width ratio of the second microstructure, and a specific volume of the third microstructure is greater than a specific volume of the first microstructure.

11. The manufacturing method for an optical anti-counterfeiting element as claimed in claim 10, further comprising: S4) placing a semi-finished product in S3) into an atmosphere capable of reacting with the first coating until part or all of the first coating and the second coating which are located in the third region are removed.

12. The manufacturing method for an optical anti-counterfeiting element as claimed in claim 11, wherein

the first coating or the second coating in S3) comprises an aluminum layer, or the first coating and the second coating in S3) comprise an aluminum layer; and an acid liquor and/or an alkali liquor are/is selected as the atmosphere capable of reacting with the first coating and/or the second coating in S3).

13. The manufacturing method for an optical anti-counterfeiting element as claimed in any one of claims 9-12, further comprising: applying an inorganic or organic coating or a painting layer process.

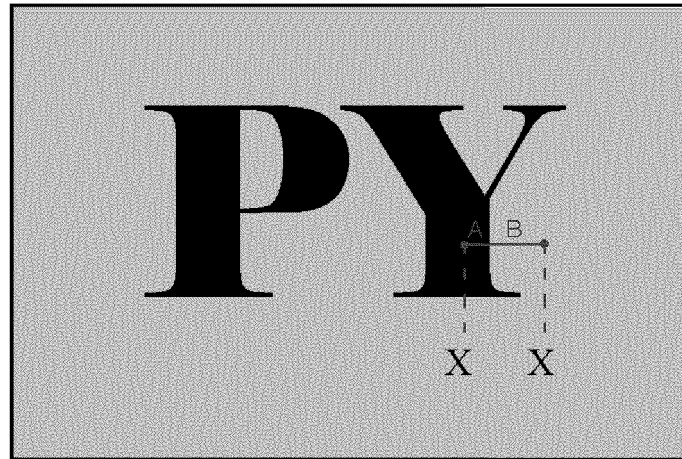


Fig. 1

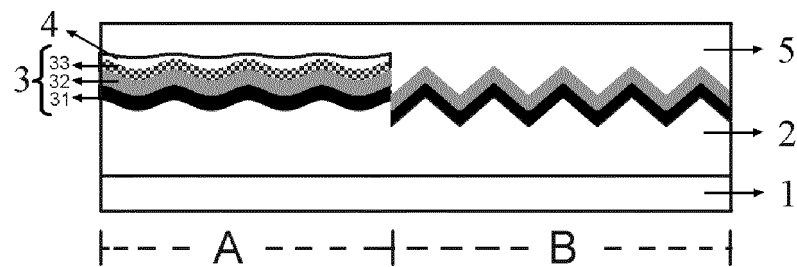


Fig. 2

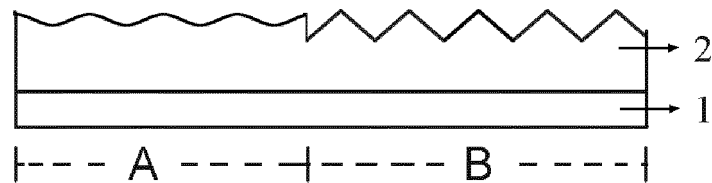


Fig. 3

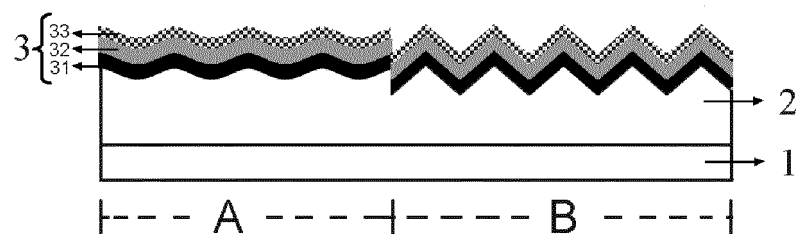


Fig. 4

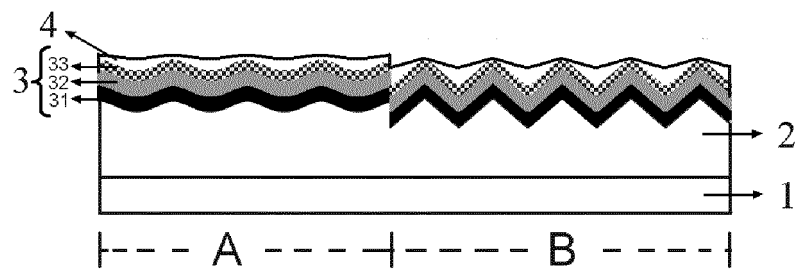


Fig. 5

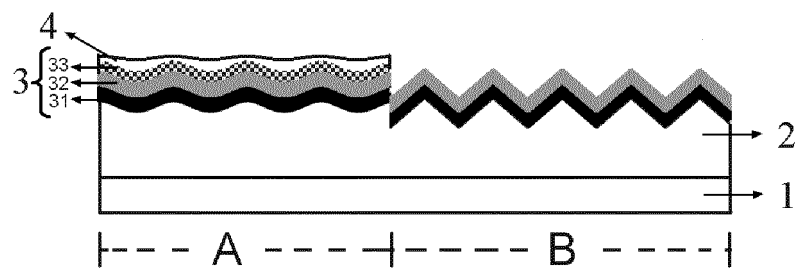


Fig. 6

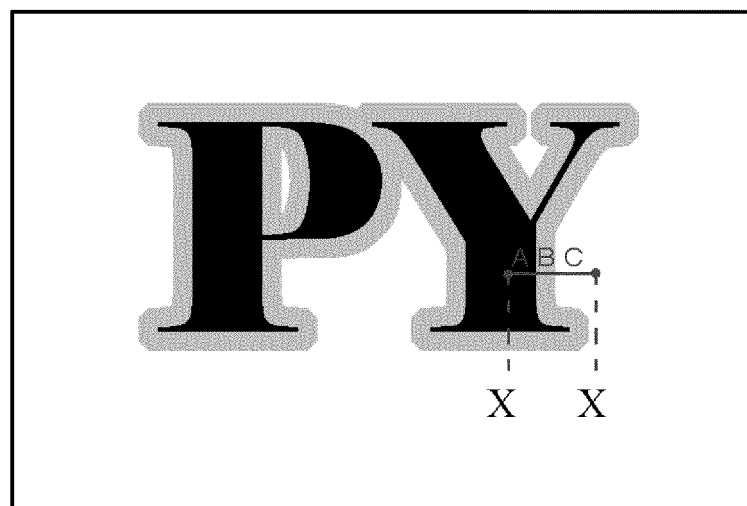


Fig. 7

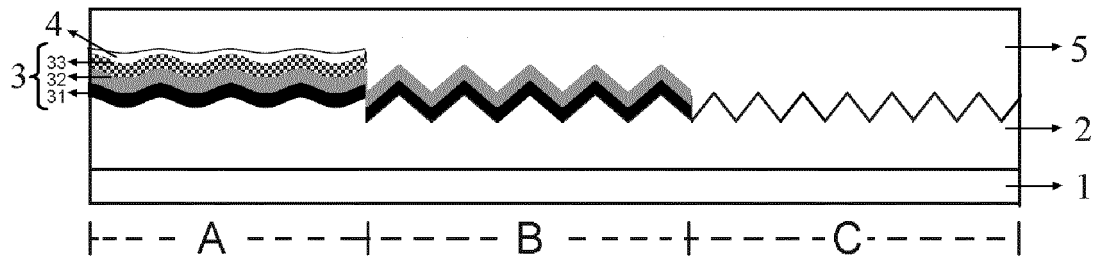


Fig. 8

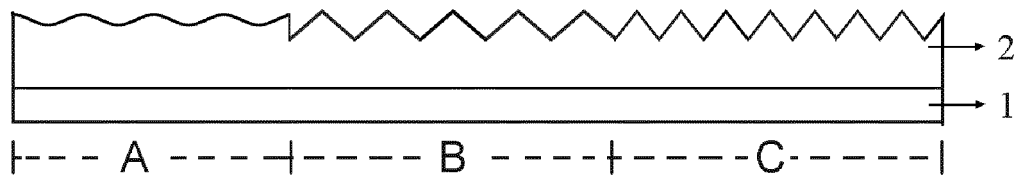


Fig. 9

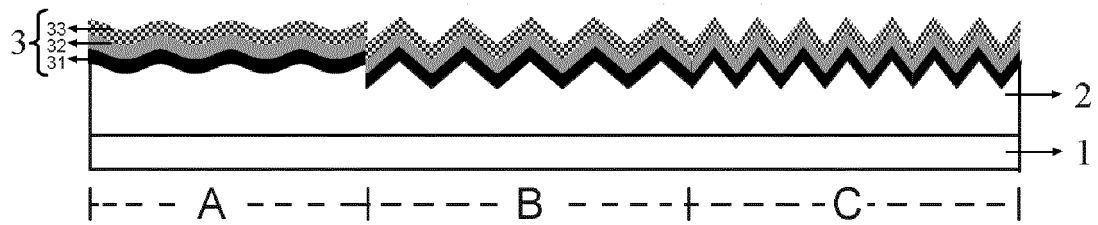


Fig. 10

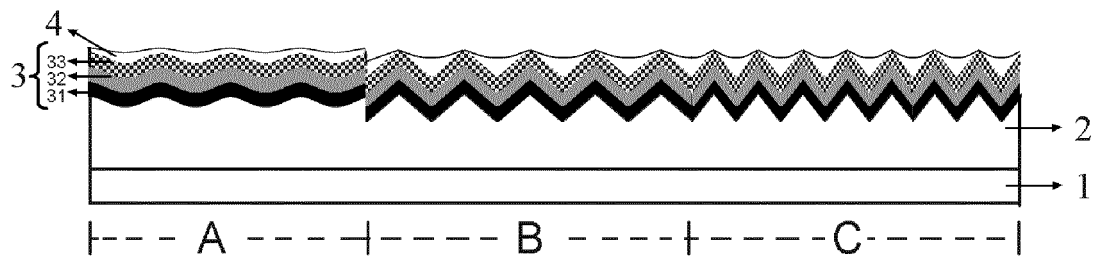


Fig. 11

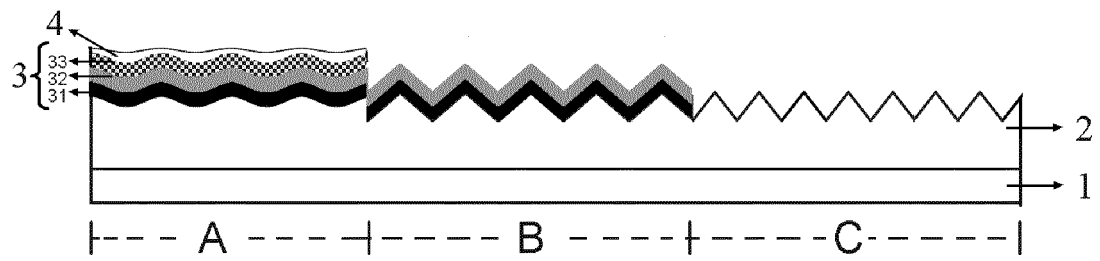


Fig. 12

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2020/115557

5	A. CLASSIFICATION OF SUBJECT MATTER		
	B42D 25/328(2014.01)i		
	According to International Patent Classification (IPC) or to both national classification and IPC		
10	B. FIELDS SEARCHED		
	Minimum documentation searched (classification system followed by classification symbols) B42D 25/-		
	Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
15	Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) VEN; CNABS; CNKI: 安全, 防伪, 多层, 微结构, 光学, 介电, 镀, safe+, security, false, fak+, multi+, layer, micro, structure, optical, optics, dielectric, coat+, plat+		
	C. DOCUMENTS CONSIDERED TO BE RELEVANT		
20	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	X	CN 105015215 A (ZHONGCHAO SPECIAL SECURITY TECHNOLOGY CO., LTD. et al.) 04 November 2015 (2015-11-04) description, paragraphs [0018]-[0049], and figures 1-7	1-13
25	X	CN 104647938 A (ZHONGCHAO SPECIAL SECURITY TECHNOLOGY CO., LTD. et al.) 27 May 2015 (2015-05-27) description, paragraphs [0020]-[0049], and figures 1-10	1-13
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30	A	EP 1182054 B1 (OVD KINEGRAM AG) 13 May 2009 (2009-05-13) entire document	1-13
35	☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
40	* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
45			
50	Date of the actual completion of the international search 30 October 2020		Date of mailing of the international search report 19 November 2020
55	Name and mailing address of the ISA/CN China National Intellectual Property Administration (ISA/CN) No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088 China Facsimile No. (86-10)62019451		Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

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REFERENCES CITED IN THE DESCRIPTION

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