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(54) PLASMA IONIZATION DEPOSITION METHOD FOR STRENGTHENED WEAR-RESISTANT METAL SURFACE AND STRUCTURE THEREOF

(57) A plasma ionization deposition method for a strengthened wear-resistant metal surface and a structure thereof are provided, in which a metallic main body (1) is taken as a base, and a laser technique is first applied to generate a plurality of receiving holes (11) in a surface of the metallic main body (1), a plasma ionization technique being applied to ionize dimethicone to deposit and form dimethicone connecting parts (2) in the receiving holes (11) and the surface of the metallic main body (1), and an electroplating technique being applied to electrolyze an epoxy resin to form an epoxy resin color-rendering layer (3) on the dimethicone connecting parts (2), and finally, a plasma ionization technique is applied to ionize an oxide in order to form an oxide hardening layer (4) on the epoxy resin color-rendering layer (3). As such, the dimethicone connecting parts (2) securely bond the metallic main body (1) and epoxy resin color-rendering layer (3), and the nanometer oxide hardening layer (4) is uniformly deposited on the surface to enhance hardness. Balance among aesthetics, hardness, toughness, and corrosion resistance may be achieved.

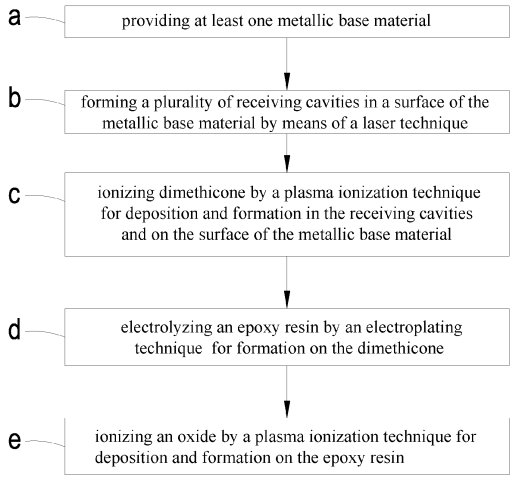

FIG. 5

EP 4 119 702 A1

Description

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to a plasma ionization deposition method for a strengthened wear-resistant metal surface and a structure thereof, and more particularly to a plasma ionization deposition method for a strengthened wear-resistant metal surface and a structure thereof that demonstrate colors of vividness and brightness, toughness for impact resistance, hardness for wear resistance and scratch resistance, and weatherability for corrosion resistance.

DESCRIPTION OF THE PRIOR ART

[0002] Products of well-known brand names are attached with brand logos, which are the most directly observable parts for consumers. To maintain the reputation of the brands, establish good images, and meet the high standard that general consumers require for famous brands, the brand logos are commonly made as beautiful metal products, and consequently, other metal accessories on the products have to be made of metals of similar or identical beautifulness.

[0003] For consumers, products of famous brands stand for both gorgeousness and long-wearing. Such products are expected to look just new ones even having been kept for years or having been subjected to various impacts and abrasions. In other words, they just have to be of vivid and bright color, hardness to resist wear and impact, and inertness to resist corrosion.

[0004] In respect of tests for metal surface coatings, those demonstrating excellent chemical tests may have good corrosion resistance, yet they may contain a large amount of carbon and thus exhibit a relatively dull and dim color, such as red and black, and does not show brightness and vividness in color. Physical tests generally include impact tests, adhesion tests, and wear resistance tests. High impact resistance requires toughness, yet high wear resistance requires hardness, and consequently, it is hard to have a property that is good for resisting both wear and impact. Further, high adhesion requires elasticity, yet high wear resistance requires hardness, and consequently, it is hard to balance between pigment adhering power and hardness against wear.

[0005] For the contemporary technology, to improve adhesion between pigments and metals, it is a common practice to implement sand blasting or acid etching to make voids or cavities on a metal surface to increase adhesion power of a pigment filled therein. Voids or cavities so formed are irregular and it is not possible to control the diameters, depths, quantities, and locations of such voids or cavities. Consequently, it is often that detaching occurs in some localized areas. Further, the pigment is still directly bonded to the metal surface that is generally rigid, so that toughness of the bonding is not good. Further, bright and vivid coatings that are commonly known can only be directly coated on iron pieces, copper pieces, and aluminum alloy pieces, because these three types of metals have large surface pores. However, in view of the property of corrosion resistance, stainless steels have relatively small surface pores and this makes it hard for coating to attach thereto.

[0006] Further, a base material of high hardness often has a surface that is irregular and unsmooth and may be easily attached with dust, leading to poor optical properties, and is thus not glossy and shining. Using such a material to cover a product in order to enhance the hardness of the product would inevitably sacrifice aesthetics of the product.

SUMMARY OF THE INVENTION

[0007] In view of the above, the present invention aims to provide a plasma ionization deposition method for a strengthened wear-resistant metal surface and a structure thereof that demonstrate colors of vividness and brightness, toughness for impact resistance, hardness for wear resistance and scratch resistance, and weatherability for corrosion resistance.

[0008] The primary objective of the present invention is that laser is applied to form uniform minute pores on a metallic main body and a plasma ionization technique is applied to fill dimethicone connecting parts therein for securely bonding an epoxy resin color-rendering layer, and finally an oxide hardening layer is coated on a surface, so that balance can be achieved among aesthetics, wear resistance, and impact resistance.

[0009] To achieve the above objective, the present invention provides a main structure that comprises: at least one metallic main body, a plurality of receiving holes formed on the metallic main body, a plurality of dimethicone connecting parts deposited and formed in the receiving holes, respectively, and extended to a surface of the metallic main body, an epoxy resin color-rendering layer bonded on the dimethicone connecting parts, and an oxide hardening layer deposited and formed on the epoxy resin color-rendering layer.

[0010] In manufacturing, with the metallic main body being taken as a base, a laser technique is applied to generate the plurality of receiving holes in the surface of the metallic main body, and a plasma ionization technique is applied to ionize dimethicone in order to deposit and form dimethicone connecting parts in the receiving holes and on the surface of the metallic main body, and then, an electroplating technique is applied to electrolyze an epoxy resin in order to form an epoxy resin color-rendering layer on the dimethicone connecting parts, and finally, a plasma ionization technique is applied to ionize an oxide in order to deposit and form an oxide hardening layer on the epoxy resin color-rendering layer. As such, distribution and size of the receiving holes can be controlled so that the dimethicone connecting parts may securely bond the metallic main body and epoxy resin color-

rendering layer together and a color that is tough and vivid and is not easy to detach is formed on the surface of the metallic main body, and then, the oxide hardening layer in a nanometer state is uniformly deposited on the surface to improve hardness, and therefore, advantages of aesthetics, wear resistance, and impact resistance can all be achieved for the metallic main body.

[0011] Based on the above technology, the problems that the prior art metal surface coatings cannot simultaneously possess good corrosion resistance and vivid and bright colors, cannot simultaneously achieve properties of both wear resistance and impact resistance, and cannot simultaneously realize both adhesion for colors and hardness for wear resistance can be overcome, and practical advantages for utilization can be achieved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

FIG. 1 is a schematic view demonstrating laser hole forming according to a preferred embodiment of the present invention.

FIG. 2 is a schematic view demonstrating dimethicone depositing according to the preferred embodiment of the present invention.

FIG. 3 is a schematic view demonstrating epoxy resin depositing according to the preferred embodiment of the present invention.

FIG. 4 is a schematic view demonstrating oxide depositing according to the preferred embodiment of the present invention.

FIG. 5 is a block diagram showing a method according to a preferred embodiment of the present invention.

FIG. 6 is a perspective view showing the preferred embodiment of the present invention.

FIG. 7 is a cross-sectional view of the preferred embodiment of the present invention taken along line A-A of FIG. 6.

FIG. 8 is a schematic view showing a structure of receiving holes according to the preferred embodiment of the present invention.

FIG. 9 is a structure block diagram showing the preferred embodiment of present invention.

FIG. 10 is a schematic view showing a state of use of the preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0013] Referring to FIGS. 1-10, which are respectively a schematic view demonstrating laser hole forming according to a preferred embodiment of the present invention, a schematic view demonstrating dimethicone depositing according to the preferred embodiment of the present invention, a schematic view demonstrating epoxy resin depositing according to the preferred embodiment of the present invention, a schematic view demonstrating oxide depositing according to the preferred embodiment of the present invention, a block diagram showing a method according to a preferred embodiment of the present invention, a perspective view showing the preferred embodiment of the present invention, a cross-sectional view of the preferred embodiment of the present invention taken along line A-A of FIG. 6, a schematic view showing a structure of receiving holes according to the preferred embodiment of the present invention, a structure block diagram showing the preferred embodiment of present invention, and a schematic view showing a state of use of the preferred embodiment of the present invention, the drawings clearly show that the present invention comprises:

at least one metallic main body 1, the metallic main body 1 being stainless steel;

a plurality of receiving holes 11 formed on the metallic main body 1, the receiving holes 11 being minute pores formed by means of a laser technique, the receiving holes 11 having a hole diameter in a range from 180 micrometers (μm) to 230 micrometers (μm), the receiving holes 11 having a depth in a range from 25 micrometers (μm) to 55 micrometers (μm);

a plurality of dimethicone connecting parts 2 respectively formed in the receiving holes 11 and extended to a surface of the metallic main body 1, the dimethicone connecting parts 2 being formed through deposition by means of a plasma ionization technique;

an epoxy resin color-rendering layer 3 attached on the dimethicone connecting parts 2, the epoxy resin color-rendering layer 3 being formed through deposition by means of an electroplating technique; and

an oxide hardening layer 4 formed on the epoxy resin color-rendering layer 3, the oxide hardening layer 4 being formed through deposition by means of a plasma ionization technique, the oxide hardening layer 4 comprising an oxide that is one of silicon dioxide and zirconium dioxide.

[0014] A plasma ionization deposition method for a strengthened wear-resistant metal surface according to the present invention comprises the following main steps:

(a) providing at least one metallic main body;

(b) forming a plurality of receiving holes in a surface of the metallic main body by means of a laser technique;

(c) ionizing dimethicone by a plasma ionization technique in order to deposit and form a dimethicone connecting part in the receiving holes and on the surface of the metallic main body;

(d) electrolyzing an epoxy resin by an electroplating technique in order to form an epoxy resin color-ren-

dering layer on the dimethicone connecting part; and (e) ionizing an oxide by a plasma ionization technique in order to deposit and form an oxide hardening layer on the epoxy resin color-rendering layer.

[0015] Based on the description provided above, the structure of the present invention can be readily appreciated. Based on such a structure, various advantages in respect of colors of vividness and brightness, toughness for impact resistance, hardness for wear resistance and scratch resistance, and weatherability for corrosion resistance, can be achieved. A more detailed description will be provided below.

[0016] The metallic main body 1 comprises a material of stainless steel. The receiving holes 11 are minute pores of identical hole diameter, identical depth, and identical spacing distance. For example, a preferred value of the hole diameter is 206 μm; a preferred value of the hole depth is 40 μm; and a preferred hole spacing distance is approximately 1.5 times of the hole diameter. Dimethicone functions as a connecting component having elasticity and does not dissolve in water and oil and has excellent stability. Epoxy resin is a commonly used coating material and is capable of rendering a desired color and can intactly exhibits a vivid and bright color. The oxide is provided, as an example of illustration, as silicon dioxide (SiO_2). Silicon dioxide is also known as a ceramic-like or glasslike material, which is a substance that is resistant to wear and scratch. The types of the above components are provided as examples of a preferred embodiment, and types having the same functions are all considered belonging to the scope of the present invention, and not limited to the above examples.

[0017] In actual manufacturing, as shown in FIGS. 1, 5, 6, and 8, a metallic main body 1 having a material of stainless steel has pores that are relatively small, so that a coating, such as epoxy resin, cannot be directly attached thereto. Therefore, a laser etching technique is applied on a surface of the metallic main body 1 to form a large quantity of uniformly distributed receiving holes 11, by which the pore size of the metallic main body 1 is evenly increased. As shown in FIGS. 2 and 5, to improve a bonding or attaching strength between epoxy resin and the metallic main body 1, a plasma ionization technique is applied to ionize dimethicone into a nanometer state, so that the dimethicone is filled into interiors of the receiving holes 11, in such a way that the dimethicone connecting parts 2 are each just like an arrangement of growing roots in the interiors of the receiving holes 11. Since the receiving holes 11 are large in number and are distributed in a uniform manner, the dimethicone connecting parts 2 that are in the nanometer state provide an extremely large contact surface area that allows for securely connecting with an object in contact therewith. In the instant embodiment, two ends of the dimethicone connecting part 2 are respectively connected to the metallic main body 1 and the epoxy resin color-rendering layer 3 (also see FIG. 3).

[0018] As shown in FIGS. 3 and 5, the metallic main body 1 on which the dimethicone connecting parts 2 are formed is placed in an electroplating environment, in which an electroplating technique is applied to electrolyze epoxy resin for attaching to the dimethicone connecting parts 2 to form the epoxy resin color-rendering layer 3, so that with toughness being enhanced with the elasticity of dimethicone and appearance aesthetics being improved with the easily coloring property of epoxy resin, colors that are tough and vivid and are not easily detached can be provided on the surface of the metallic main body 1.

[0019] As shown in FIGS. 4 and 5, a plasma ionization technique is similarly applied to ionize the oxide (such as silicon dioxide) to show a fine, nanometer-like state in order to uniformly deposit on a surface of the epoxy resin color-rendering layer 3 to form the oxide hardening layer 4. Due to high hardness of the oxide hardening layer 4, an excellent effect of wear resistance and scratch resistance is realized. Further, due to an effect of coating resulting from the nanometer-like state, the surface is glossy and does not easily accumulate dust thereon, and in addition, the material of silicon dioxide, which is generally considered a glasslike material, is a light-transmitting material so that the color of the epoxy resin color-rendering layer 3 on the under layer can still be exhibited. In view of the deposition based manufacturing method and the structure described above, improvements in respect of colors of vividness and brightness, toughness for impact resistance, hardness for wear resistance and scratch resistance, and weatherability for corrosion resistance, can be achieved.

[0020] As shown in FIGS. 7, 9, and 10, a product made according to the present invention can be attached to a commercial object 5, so that aesthetics, hardness, and toughness can be realized by means of the structure of the present invention, making the commercial object 5 demonstrating high quality to meet the needs of famous brands for metal accessories (the metallic main body 1).

[0021] According to experimental tests provided below, the present invention is proven as a metal exhibiting various advantages in respect of aesthetics, wear resistance, and impact resistance. For chemical tests, under artificial perspiration tests of coating standard NFS 80-772, the present invention passes weatherability test for requirement of 24 hours and extreme of 36 hours; under constant temperature and constant humidity test of coating standard IS04611, the present invention passes weatherability tests for requirement of 96 hours and extreme of 120 hours; under salt spray tests of coating standard ISO9227, the present invention passes weatherability test for requirement of 96 hours and extreme of 120 hours; and under lead content tests of coating standard for being less than or equal to 300ppm, the present invention passes the weatherability test. For physical tests, under the falling tests of coating standard of overall height 210 cm, one 45-degree cement plate being disposed at every 30 cm, requiring no flake-like peeling or

signification film explosion, the present invention passes test of impact resistance for 10 times; under the three-dimensional roller tests of standard coating for rolling for 30 minutes at a rotational speed of 72 rpm, the abrading material being emery, requiring no exposure of the base material, the present invention passes test of wear resistance for 30 minutes and extreme of 40 minutes; and under standard coating 100-grid tests, the present invention passes test of adhesion.

Claims

1. A plasma ionization deposition method for a strengthened wear-resistant metal surface, of which main steps comprise:

   (a) providing at least one metallic main body (1);
   (b) forming a plurality of receiving holes (11) in a surface of the metallic main body (1) by means of a laser technique;
   (c) ionizing dimethicone by a plasma ionization technique in order to deposit and form a dimethicone connecting part (2) in the receiving holes (11) and on the surface of the metallic main body (1);
   (d) electrolyzing an epoxy resin by an electroplating technique in order to form an epoxy resin color-rendering layer (3) for formation on the dimethicone connecting part (2); and
   (e) ionizing an oxide by a plasma ionization technique in order to deposit and form an oxide hardening layer (4) on the epoxy resin color-rendering layer (3).

2. The plasma ionization deposition method for a strengthened wear-resistant metal surface according to claim 1, wherein the metallic main body (1) comprises stainless steel.

3. The plasma ionization deposition method for a strengthened wear-resistant metal surface according to claim 1, wherein the receiving holes (11) have a hole diameter in a range from 180 micrometers (μm) to 230 micrometers (μm); and the receiving holes (11) have a depth in a range from 25 micrometers (μm) to 55 micrometers (μm).

4. The plasma ionization deposition method for a strengthened wear-resistant metal surface according to claim 1, wherein the oxide comprises one of silicon dioxide and zirconium dioxide.

5. A plasma ionization deposition structure of a strengthened wear-resistant metal surface, mainly comprising:

   at least one metallic main body (1);
   a plurality of receiving holes (11) formed on the metallic main body (1);
   a plurality of dimethicone connecting parts (2) respectively formed in the receiving holes (11) and extended to a surface of the metallic main body (1);
   an epoxy resin color-rendering layer (3) attached on the dimethicone connecting parts (2); and
   an oxide hardening layer (4) formed on the epoxy resin color-rendering layer (3).

6. The plasma ionization deposition structure of the strengthened wear-resistant metal surface according to claim 5, wherein the metallic main body (1) comprises stainless steel.

7. The plasma ionization deposition structure of the strengthened wear-resistant metal surface according to claim 5, wherein the oxide hardening layer (4) comprises one of silicon dioxide and zirconium dioxide.

8. The plasma ionization deposition structure of the strengthened wear-resistant metal surface according to claim 5, wherein the receiving holes (11) are minute pores formed with a laser technique.

9. The plasma ionization deposition structure of the strengthened wear-resistant metal surface according to claim 5, wherein the receiving holes (11) have a hole diameter in a range from 180 micrometers (μm) to 230 micrometers (μm); and the receiving holes (11) have a depth in a range from 25 micrometers (μm) to 55 micrometers (μm).

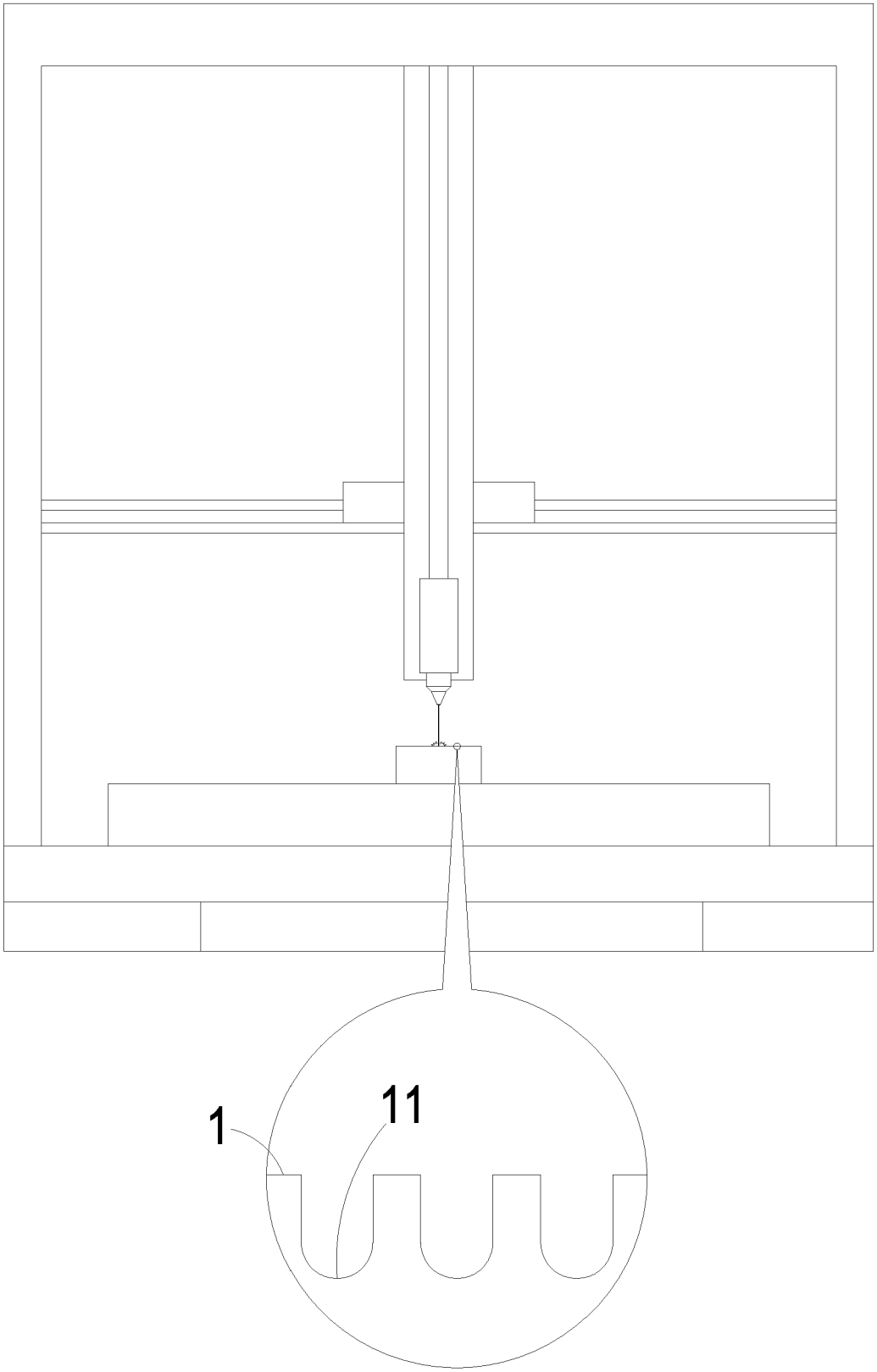

FIG. 1

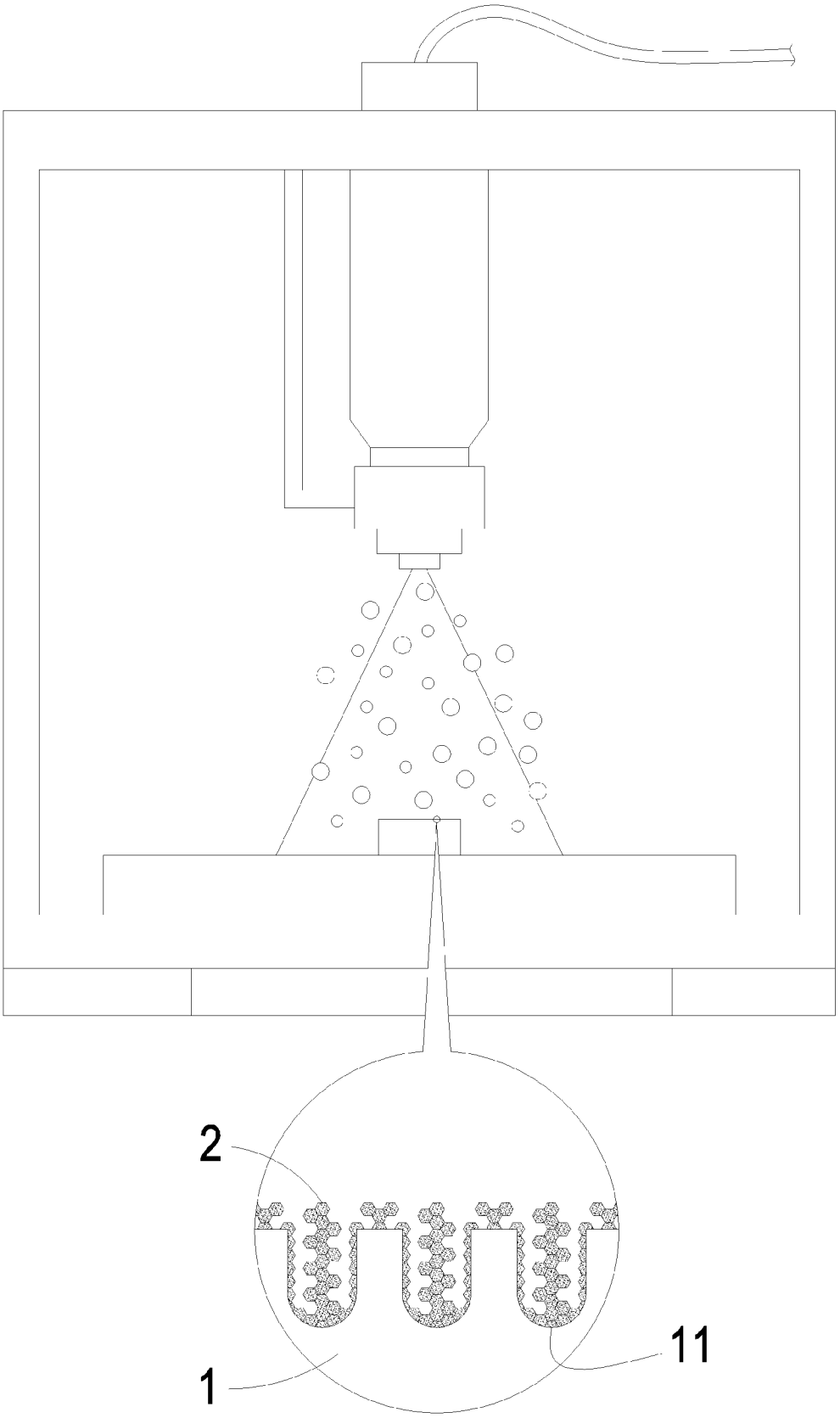

FIG. 2

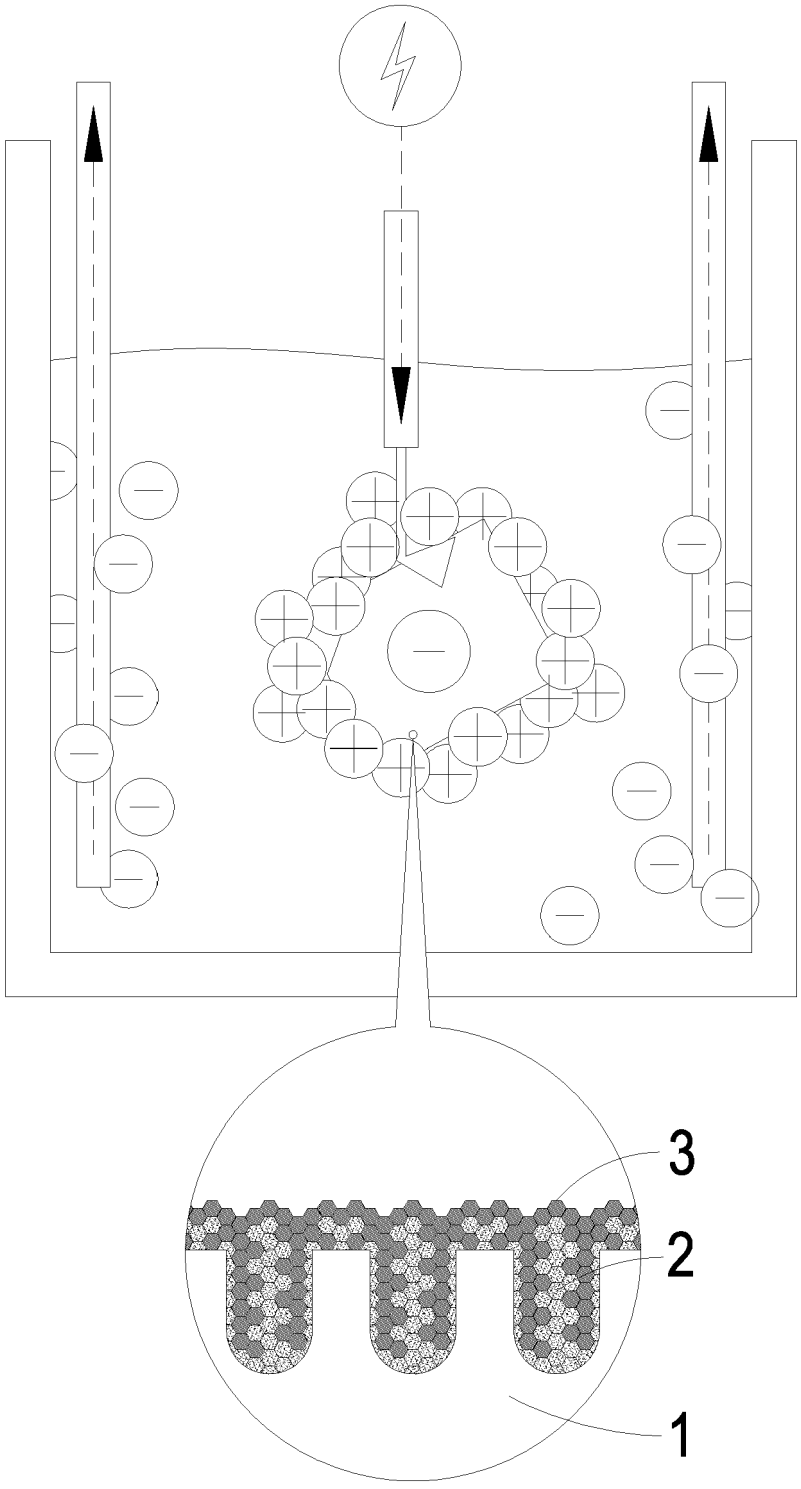

FIG. 3

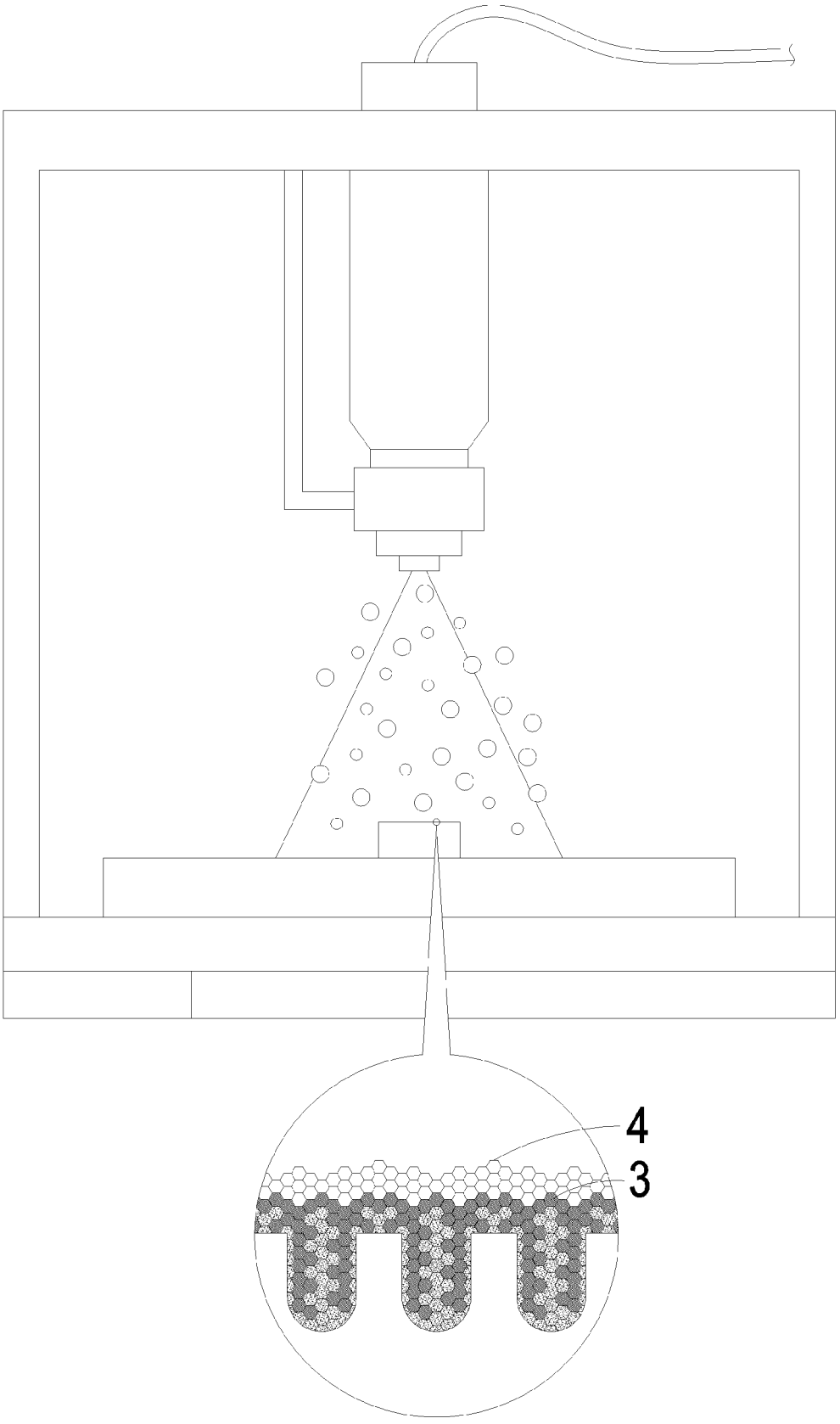

FIG. 4

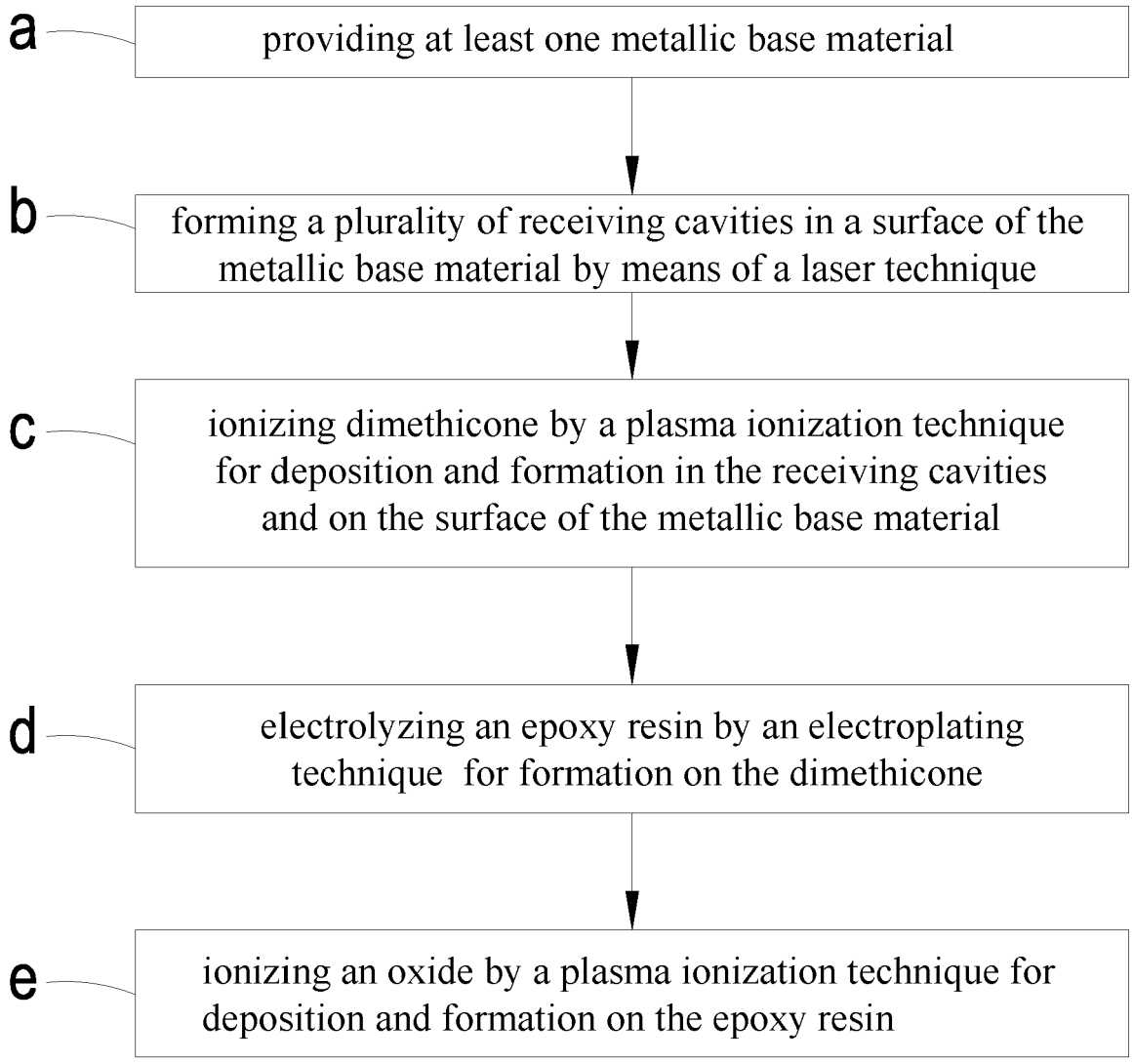
a
providing at least one metallic base material
b
forming a plurality of receiving cavities in a surface of the metallic base material by means of a laser technique
c
ionizing dimethicone by a plasma ionization technique for deposition and formation in the receiving cavities and on the surface of the metallic base material
d
electrolyzing an epoxy resin by an electroplating technique for formation on the dimethicone
e
ionizing an oxide by a plasma ionization technique for deposition and formation on the epoxy resin

FIG. 5

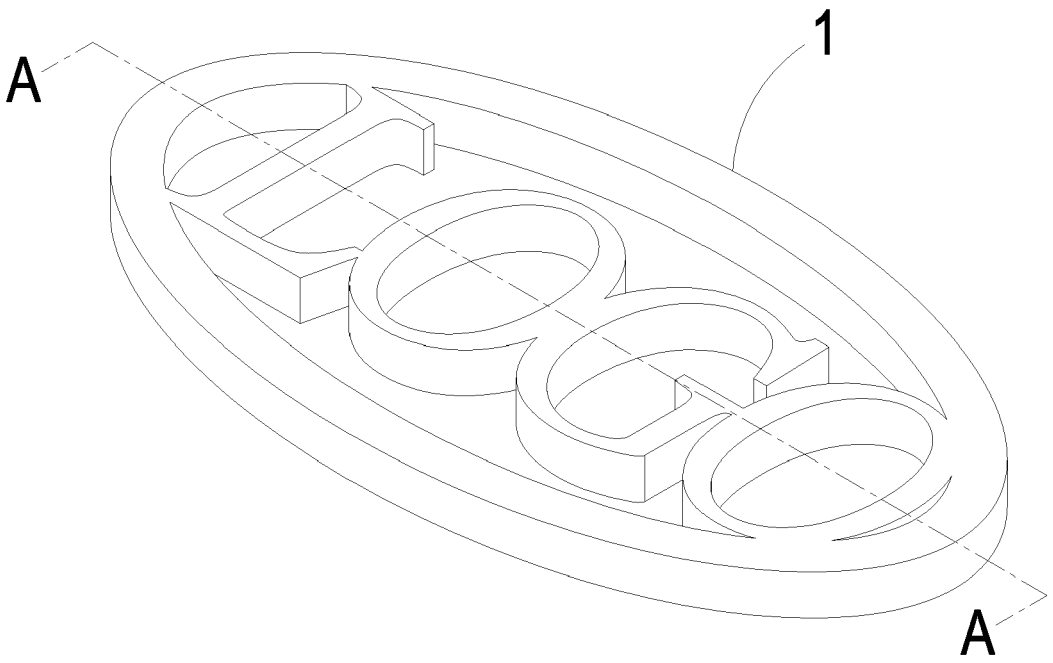

FIG. 6

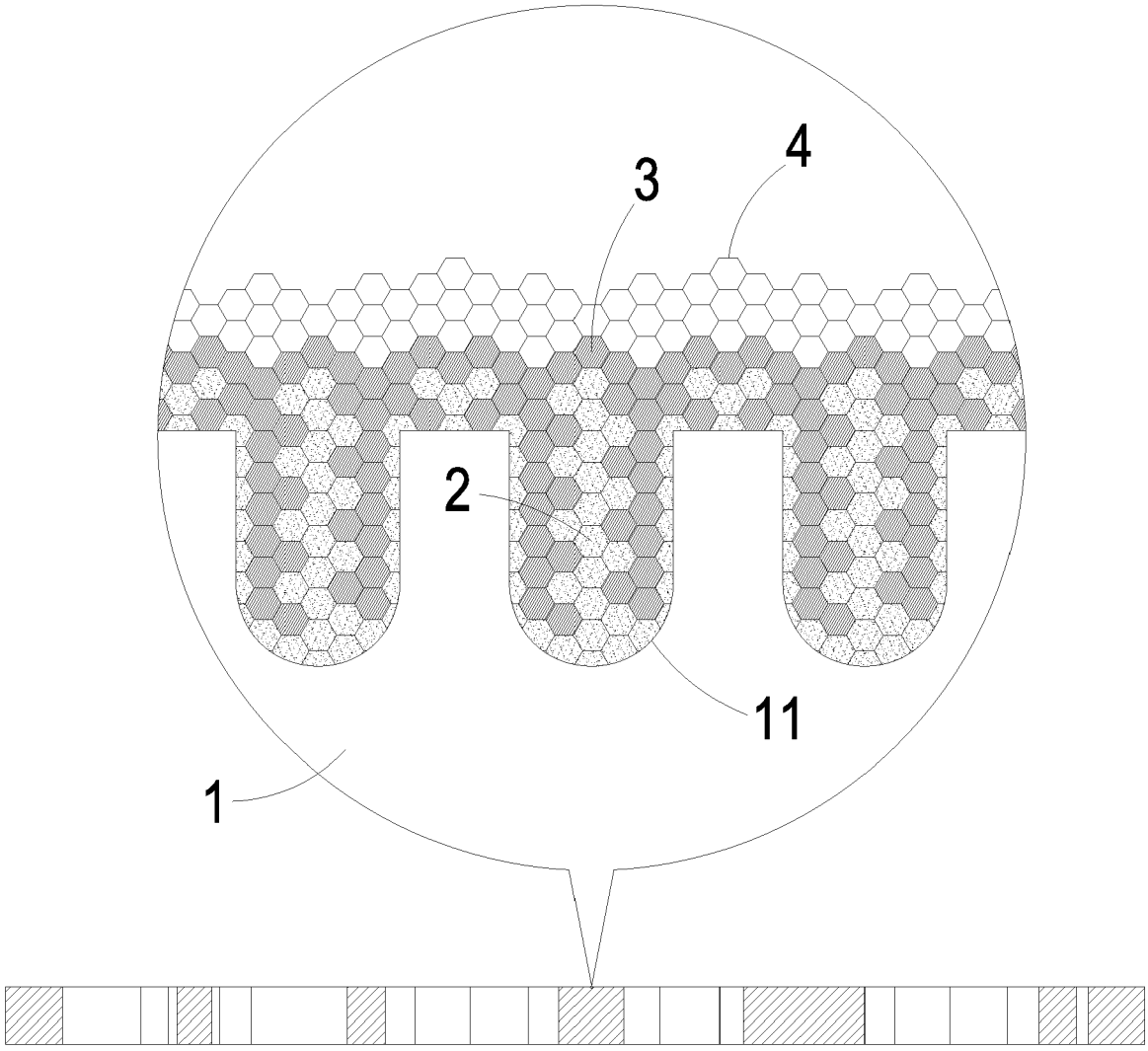

FIG. 7

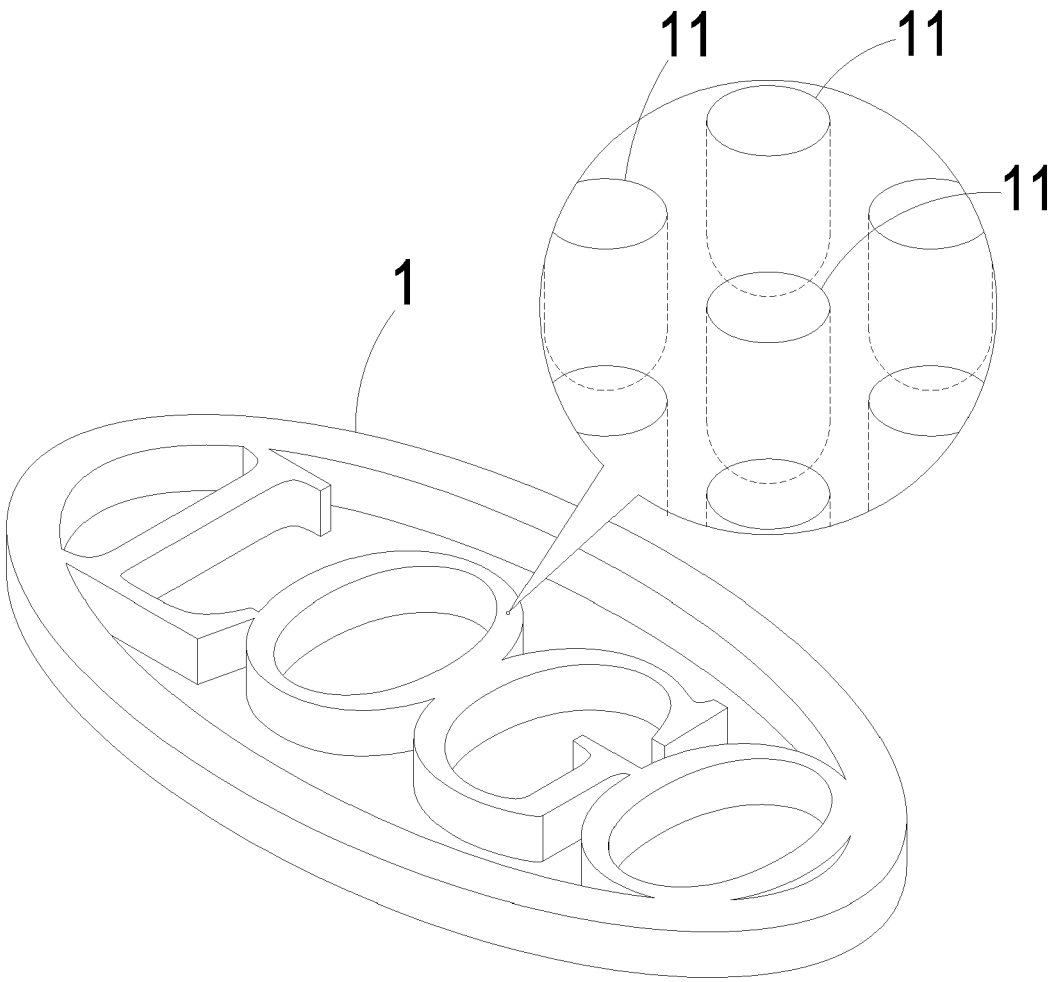

FIG. 8

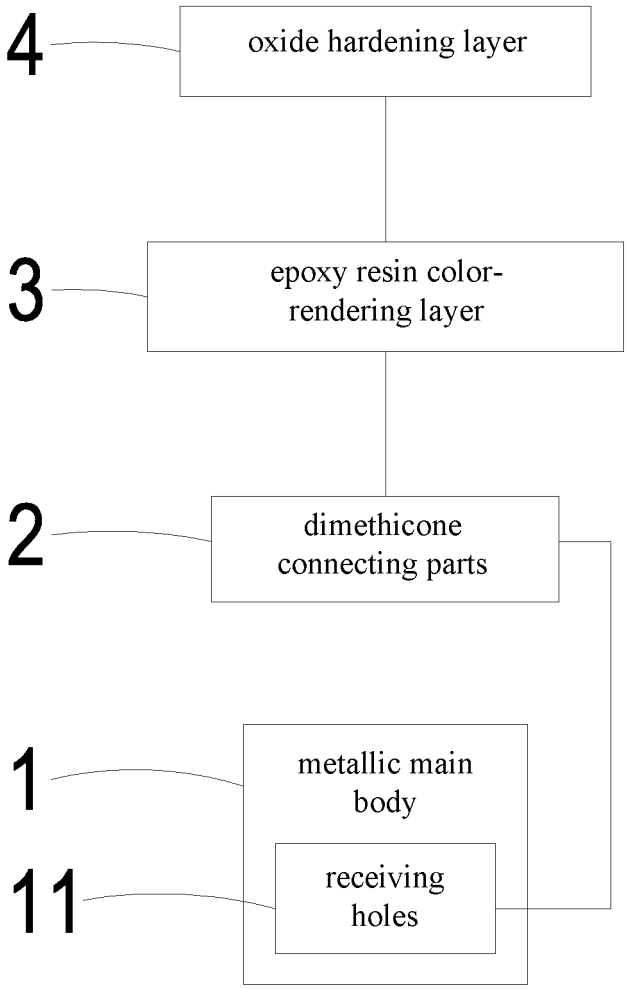
4
oxide hardening layer
3
epoxy resin color-rendering layer
2
dimethicone connecting parts
1
metallic main body
11
receiving holes

FIG. 9

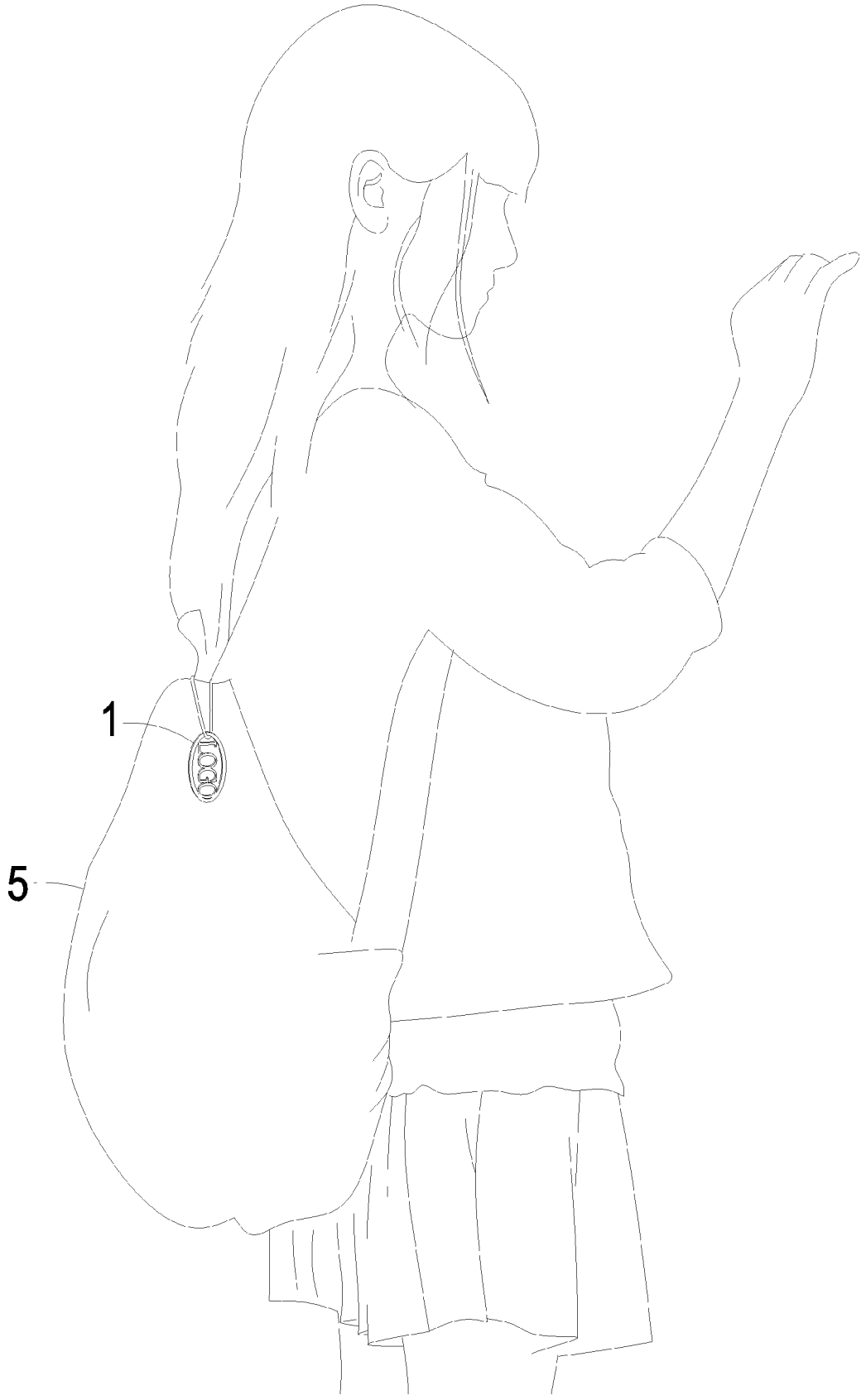

FIG. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 22 18 4035

DOCUMENTS CONSIDERED TO BE RELEVANT

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A	KOTTE LILIANA ET AL: "Atmospheric Plasma Deposition of SiO2 Films for Adhesion Promoting Layers on Titanium", METALS, vol. 4, no. 4, 22 December 2014 (2014-12-22), pages 639-646, XP055976685, DOI: 10.3390/met4040639 * 2. Experimental Section * -----	1-9	TECHNICAL FIELDS SEARCHED (IPC) C25D B05D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	3 November 2022	Le Hervet, Morgan

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 18 4035

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