

DESCRIPTION

SURFACE TREATMENT METHOD FOR ORNAMENTAL PARTS AND
ORNAMENTAL PARTS PRODUCED BY THE METHOD

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to a surface treatment method for
ornamental parts and ornamental parts produced by the method.

Description of the Prior Art

Ornamental parts such as outer casings of watches are
required to have excellent aesthetic appearances.

Conventionally, in order to satisfy this requirement,
metallic materials having silver-white color have been widely
used as constituent materials for the ornamental parts.

Examples of such metallic materials include Pd, Rh, Pt,
and the like. However, all of these metallic materials are
precious metals, thus resulting in a problem in that
manufacturing costs thereof become high.

Other examples of the metallic materials having
silver-white color besides the precious metals mentioned above
include Ti, Cr and the like. However, these metallic materials
have relatively low reflectance, and therefore their high
quality feeling is poor. For this reason, there are cases that
the produced ornamental parts can not have aesthetic
appearances of satisfactory level.

In addition, in the case where an outer surface of a base
of an ornamental part is coated with a coating layer made of
a metallic material as described above, there is a case that
the adhesion between the coating layer and the base as well as
the corrosion resistance of the ornamental part become poor.

DISCLOSURE OF THE INVENTION

The object of the present invention is to provide ornamental parts having excellent aesthetic appearances of silver luster and a surface treatment method that can provide such ornamental parts.

In order to achieve the above object, the present invention is directed to a surface treatment method for ornamental parts, which comprises the steps of preparing a base having a surface; and forming a coating layer composed of a stainless steel on at least a part of the surface of the base using a dry plating method.

According to this method, it is possible to provide ornamental parts having aesthetic appearances of silver luster.

Another aspect of the present invention is also directed to a surface treatment method for ornamental parts, which comprises the steps of preparing a base having a surface; forming at least one primary layer on at least a part of the surface of the base; and forming a coating layer composed of a stainless steel on at least a part of the primary layer using a dry plating method.

According to this method, it is also possible to provide ornamental parts having aesthetic appearances of silver luster.

In these methods described above, it is preferred that the coating layers are formed using ion plating. This makes it possible to easily form a uniform coating layer having excellent adhesion with the bases. As a result, the durability of the ornamental parts becomes especially excellent.

Other aspect of the present invention is also directed to a surface treatment method for an ornamental part, comprising

the steps of: preparing a base made of a metallic material and having a surface; forming at least one primary layer on at least a part of the surface of the base; and forming a coating layer composed of a stainless steel on at least a part of the primary layer by means of ion plating.

According to this method, it is also possible to provide ornamental parts having aesthetic appearances of silver luster.

In these methods, it is preferred that the base is made of an alloy containing at least one of Cu, Zn and Ni. This makes it possible to realize especially excellent adhesion between the base and the coating layer. Further, the processability of the base is improved, and therefore the degree of freedom in forming the base is further increased.

Further, in these methods, it is preferred that the base is formed by either of casting or metal injection molding. This makes it possible to obtain a base having a complicated shape with relative ease.

Further, it is also preferred that at least one of the primary layers functions as a buffer layer which buffers the potential difference between one surface of the layer and the other surface thereof. This makes it possible to effectively prevent corrosion from being caused by the potential difference between the base and the coating layer, that is corrosion caused by the contact of the different metals.

Other aspect of the present invention is also directed to a surface treatment method for an ornamental part, which comprises the steps of preparing a base made of a non-metallic material and having a surface; forming at least one primary layer on at least a part of the surface of the base; and forming a coating layer composed of a stainless steel on at least a part of the surface of the primary layer by means of ion plating.

According to this method, it is also possible to provide ornamental parts having aesthetic appearances of silver luster.

In these method, it is preferred that the primary layer is composed of at least one of Cu, Co, Pd, Au, Ag, In, Sn, Ni, Ti, Zn, Cr, Al and Fe, or an alloy containing at least one of the metals. This also makes it possible to effectively prevent corrosion from being caused by the potential difference between the base and the coating layer, that is corrosion caused by the contact of the different metals.

Further, it is also preferred that the primary layer is composed of a metallic compound. This also makes it possible to effectively prevent corrosion from being caused by the potential difference between the base and the coating layer, that is corrosion caused by the contact of the different metals.

Furthermore, it is also preferred that the at least one primary layer includes two or more primary layers. This makes it possible to more effectively prevent peeling off of the coating layer and the like, and also makes it possible to further improve the durability of the ornamental part.

In this case, it is preferred that the adjacent two primary layers are formed of materials containing the same element. This makes it possible to further improve the adhesion between the adjacent primary layers. As a result, the durability of the ornamental part becomes especially excellent.

In this case, it is preferred that the same element is Cu. This also makes it possible to further improve the adhesion between the adjacent primary layers. As a result, the durability of the ornamental part becomes especially excellent.

Other aspect of the present invention is directed to a

surface treatment method for an ornamental part, which comprises the steps of: preparing a base made of a non-metallic material and having a surface; and forming a coating layer composed of a stainless steel on at least a part of the surface of the base by means of ion plating.

According to this method, it is also possible to provide ornamental parts having aesthetic appearances of silver luster.

In the above methods, it is preferred that the average thickness of the coating layer is 0.1 to 5.0 μm . Thus obtained ornamental part can have a sufficiently aesthetic appearance. Further, the coating layer is hard to be peeled off.

Further, it is also preferred that at least a part of the surface of the base is subjected to a surface treatment selected from a mirror finish processing, a hair line processing or a satin finish processing. This makes it possible to obtain ornamental parts having varieties of luster. As a result, it is possible to further improve ornamentals of the ornamental parts.

Furthermore, it is also preferred to further comprises, prior to the step of forming the coating layer, the step of performing a cleaning treatment against at least a part of the surface of the base. This also makes it possible to further improve the adhesion between the base and the coating layer. As a result, the durability of the ornamental part becomes especially excellent.

In this case, it is preferred that the cleaning treatment is a bombardment treatment. This also makes it possible to further improve the adhesion between the base and the coating layer. As a result, the durability of the ornamental part becomes especially excellent.

Further, it is also preferred that the method further comprises, prior to the step of forming the coating layer, the steps of forming a masking coating on at least a part of the surface of the coating layer, removing the coating layer on which the masking coating is not provided by using a peeling agent, and removing the masking coating. This makes it possible to easily carry out patterning of the coating layer into a predetermined shape. Further, by removing a part of the coating layer, it also becomes possible to form a pattern such as a relief formed from the portions from which the coating layer are removed and the portions in which the coating layer still remain. Furthermore, it also becomes possible to obtain more distinct color difference. With these results, the aesthetic appearance of the obtained ornamental part becomes more excellent.

In this case, it is preferred that the average thickness of the masking coating is 100 to 2000 μm . The masking coating having such average thickness is capable of exhibiting its function sufficiently. With this result, the aesthetic appearance of the obtained ornamental part becomes more excellent.

The present invention is also directed to an ornamental part which is produced by any one of the surface treatment methods described above. This makes it possible to provide ornamental parts having aesthetic appearances of silver luster.

These and other objects, structures and advantages of the present invention will be apparent from the following detailed description of the invention and the examples taken in conjunction with the appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross sectional view which shows a first

embodiment of a surface treatment method according to the present invention.

Fig. 2 is a cross sectional view which shows a second embodiment of a surface treatment method according to the present invention.

Fig. 3 is a cross sectional view which shows a third embodiment of a surface treatment method according to the present invention.

Fig. 4 is a cross sectional view which shows a fourth embodiment of a surface treatment method according to the present invention.

THE BEST MODE FOR PERFORMING OUT THE INVENTION

Hereinbelow, preferred embodiments of the surface treatment method and the ornamental parts produced by the method according to the present invention will be described with reference to the drawings.

Fig. 1 is a cross sectional view which shows a first embodiment of a surface treatment method according to the present invention and an ornamental part produced by the method.

As shown in Fig. 1, the surface treatment method of this embodiment includes a step of forming a coating layer 3 composed of a stainless steel on at least a part of the surface of a base 2 (Fig. 1a) using a dry plating method (Fig. 1b).

<Base>

The base 2 may be formed of any materials. That is, the base 2 may be formed of metallic materials or non-metallic materials.

When the base 2 is formed of any metallic material, it is possible to provide an ornamental part 1A having especially

excellent strength.

Further, when the base 2 is formed of any metallic material, the following advantages can be obtained. Namely, since a leveling effect can be enjoyed during the step of forming the coating layer 3 described below, it is possible to obtain an ornamental part 1A having a relatively small surface roughness even in the case where the base 2 has a relatively large surface roughness. This means that it is possible to perform mirror finishing on the surface of the coating layer 3 without any machining work such as grading or polishing against the surface of the base 2. Further, even in the case where the base 2 was formed by means of a MIM (metal injection molding) method and thereby the surface thereof had unevenness, it is also possible to easily obtain a coating layer 3 having a mirror finishing surface. Accordingly, by forming the base 2 from such a metallic material, it is possible to easily obtain an ornamental part having excellent luster.

On the other hand, when the base 2 is formed of a non-metallic material, it is possible to provide an ornamental part 1A which is relatively light and thus portable and which has a quiet appearance.

Further, when the base 2 is formed of a non-metallic material, it is possible to obtain a base having a desired shape with relative ease. This makes it possible to provide an ornamental part 1A having a shape that is difficult to be formed by using stainless steels.

Furthermore, when the base 2 is formed of a non-metallic material, it is also possible to obtain an effect of blocking electromagnetic noise.

Examples of metallic materials that can be used for the base 2 include various metals such as Fe, Cu, Zn, Ni, Mg, Cr,

Mn, Mo, Nb, Al, V, Zr, Sn, Au, Pd, Pt, Ag and the like, and alloys containing one or more of these metals. Among these metallic materials, Cu, Zn or Ni or alloys containing at least one of these metals is particularly preferable.

By forming the base 2 from any one of the metallic materials mentioned above, it becomes possible to improve adhesion between the base 2 and the coating layer 3 described below.

Further, by forming the base 2 from any one of the metallic materials mentioned above, the processability of the base 2 is improved and therefore the degree of freedom at molding of the base 2 is also increased.

Examples of non-metallic materials that can be used for the base 2 include plastics, ceramics, stones, woods and the like.

As for the plastics, thermoplastic resins and thermosetting resins can be mentioned. Examples of these resins include polyolefin such as polyethylene, polypropylene, ethylene-propylene copolymer, ethylene-vinyl acetate copolymer (EVA) and the like, cyclic polyolefin, denatured polyolefin, polyvinyl chloride, polyvinylidene chloride, polystyrene, polyamide (e.g. nylon 6, nylon 46, nylon 66, nylon 610, nylon 612, nylon 11, nylon 12, nylon 6-12, nylon 6-66, and the like), polyimide, polyamide imide, polycarbonate (PC), poly-(4-methylpentene-1), ionomer, acrylic resin, polymethyl methacrylate, acrylonitrile-butadiene-styrene copolymer (ABS resin), acrylonitrile-styrene copolymer (AS resin), butadiene-styrene copolymer, polyoxymethylene, polyvinylalcohol (PVA), ethylene-vinylalcohol copolymer (EVOH), polyester such as polyethylen terephthalate (PET), polybutylene terephthalate (PBT), and polycyclohexane terephthalate (PCT), polyether, polyether ketone (PEK),

polyether ether ketone (PEEK), polyether imide, polyacetal (POM), polyphenylene oxide, denatured polyphenylene oxide, polysulfone, polyether sulfone, polyphnylene sulfide, polyarylate, liquid crystal polymer such as aromatic polyester, fluoro resin such as polytetrafluoroethylene, polyfluorovinyliden and the like, various thermoplastic elastomers such as styrene based elastomer, polyolefin based elastomer, polyvinylchloride based elastomer, polyurethane based elastomer, polyester based elastomer, polyamide based elastomer, polybutadiene based elastomer, trans-polyisoprene based elastomer, fluorocarbon rubber based elastomer, chlorinated polyethylene based elastomer and the like, epoxy resins, phenolic resins, urea resins, melamine resins, unsaturated polyester, silicone resins, polyurethane resins, and the like; and copolymers, blended bodies and polymer alloys and the like having at least one of these materials as a main ingredient. Further, in this invention, a mixture of two or more kinds of these materials may be employed. Furthermore, it is also possible to form a laminate body comprised of two or more layers using two or more of the materials mentioned above, so that a base 2 is formed of such a laminate body.

When the base 2 is formed of any one of the plastic materials mentioned above, it is possible to obtain an ornamental part 1A which is relatively light and thus portable and which has a quiet appearance.

Further, when the base 2 is formed from any one of the plastic materials mentioned above, it is relatively easy to obtain a base having a desired shape. This means that it is possible to obtain an ornamental part 1A having a shape which is difficult to be formed by molding.

Furthermore, when the base 2 is formed from any one of the plastic materials, it is also possible to obtain an effect of blocking electromagnetic noise.

Example of ceramics that can be used to form the base 2 include oxide ceramics such as Al_2O_3 , SiO_2 , TiO_2 , Ti_2O_3 , ZrO_2 , Y_2O_3 , barium titanate, and strontium titanate and the like; nitride ceramics such as AlN , Si_3N_4 , SiN , TiN , BN , ZrN , HfN , VN , TaN , NbN , CrN , Cr_2N and the like; carbide ceramics such as graphite, SiC , ZrC , Al_4C_3 , CaC_2 , WC , TiC , HfC , VC , TaC , NbC and the like; boronic ceramics such as ZrB_2 , MoB and the like; and composite ceramics composed of arbitral combination of two or more of these ceramics.

When the base 2 is formed of any one of the ceramic materials mentioned above, it is possible to obtain an ornamental part 1A having high strength and high hardness.

The manufacturing method of the base 2 is not particularly limited to a specific manufacturing method.

When the base 2 is formed of any metallic material, manufacturing methods such as press, cutting, forging, casting, powder metallurgy sintering, metal injection molding (MIM), lost-wax, and the like can be selectively used. Among these manufacturing methods, casting and metal injection molding (MIM) are particularly preferred. The casting and metal injection molding (MIM) are excellent in processability. Therefore, by using either of these methods, it becomes possible to obtain a base 2 having a complicated shape with relative ease.

Normally, the metal injection method (MIM) includes the following processes.

First, a material containing a metal powder and an organic binder is mixed and kneaded to obtain a compound.

Then, the compound is injection-molded to form a green body.

Next, the green body is subjected to a debinding treatment (binder removal treatment) to obtain a brown body. This debinding treatment is normally carried out by heating under reduced pressure.

Next, thus obtained brown body is sintered to obtain a sintered body. This sintering process is normally carried at a higher temperature than the debinding treatment.

In the present invention, thus obtained sintering body can be used as a base.

On the other hand, when the base 2 is formed of any plastic as mentioned above, manufacturing methods such as compaction molding, extrusion molding, injection molding, stereo lithograph, and the like can be selectively used.

In this case, it is preferred that the surface of the base has been subjected to a surface treatment such as mirror finish processing, hair line processing, satin finish processing, and the like. This makes it possible to obtain ornamental parts 1A having surfaces of varieties of luster. As a result, it is possible to further improve ornaments of the obtained ornamental parts 1A.

In order to improve adhesion between the base 2 and the coating layer 3, a primer treatment can be made against the base 2 before the formation of the coating layer 3 described below. Examples of such primer treatment includes etching treatment; and cleaning treatment such as blasting, alkaline washing, acid washing, water washing, organic solution washing, bombardment treatment, and the like. Among these treatments, cleaning treatment is particularly preferred. By performing the cleaning treatment to the surface of the base 2, the adhesion between the base 2 and the coating layer 3 is further improved.

Further, among these treatments, the bombardment treatment is advantageous in that it can be easily applied even in the case where the base 2 is formed of any plastic described above.

<Formation of Coating Layer>

As shown in Fig. 1b, a coating layer 3 made of a stainless steel is formed on the surface of the base 2.

In this connection, it is to be noted that in this specification the term "stainless steel" means Fe-Cr based alloys or Fe-Cr-Ni based alloys. Examples of the Fe-Cr-Ni based alloys include SUS304, SUS303, SUS316, SUS316L, SUS316J1, SUS316J1L and the like. Examples of the Fe-Cr based alloys include SUS405, SUS430, US434, SUS444, SUS429, SUS430F, and the like.

Such a coating layer 3 is formed using a dry plating method, that is a vapor-phase growth method.

By forming the coating layer 3 using the dry plating method, it is possible to obtain a coating layer 3 having excellent adhesion with the base 2. As a result, the obtained ornamental part 1A can have excellent durability. Further, by forming the coating layer 3 using the dry plating method, the coating layer 3 can have excellent corrosion resistance and anti-abrasiveness.

Examples of the dry plating method includes chemical vapor deposition methods such as thermal CVD, plasma CVD, laser CVD and the like, vacuum evaporation, sputtering, ion plating, ion injection and the like. Among these methods, the ion plating is particularly preferred.

By using the ion plating method as the dry plating method, it becomes possible to relatively easily obtain an uniform

coating layer 3 having especially excellent adhesion with the base 2. As a result, the durability of the obtained ornamental part 1A can be further improved. Further, by using the ion plating method, the corrosion resistance and anti-abrasiveness of the coating layer 3 becomes especially excellent.

In this regard, the ion plating is preferably carried out under the following condition.

An ionization voltage is not particularly limited to a specific value, but it should preferably lie in the range of 20 - 600V and more preferably lie in the range of 40 - 300V.

When the ionization voltage is within the above range, it is possible to form a coating layer 3 having excellent adhesion with the base 2. Further, thus formed coating layer 3 can have less dispersion in its thickness at every portions thereof and small internal stress, so that crack would be hard to occur therein.

An ionization current is not particularly limited to a specific value, but it should preferably lie in the range of 20 - 100A and more preferably lie in the range of 40 - 70A.

When the ionization current is within the above range, it is possible to form a coating layer 3 having excellent adhesion with the base 2. Further, thus formed coating layer 3 can have less dispersion in its thickness at every portions thereof and small internal stress, so that crack would be hard to occur therein.

The average thickness of the coating layer 3 formed by the dry plating method is not particularly limited to a specific value, but it should preferably lie in the range of 0.1 - 5.0 μm and more preferably lie in the range of 0.5 - 2.5 μm .

If the average thickness of the coating layer 3 is less than the above-mentioned lower limit value, pinholes are likely to be formed in the coating layer 3, so that there is a possibility that the aesthetic appearance of the obtained ornamental part 1A is lowered.

On the other hand, if the average thickness of the coating layer 3 exceeds the above-mentioned upper limit value, there is tendency that dispersion of the thickness at various portions of the coating layer 3 becomes large. Further, the internal stress of the coating layer 3 also becomes large, thus leading to the cases where adhesion between the coating layer 3 and the base 2 is lowered and crack is likely to occur.

In this regard, it is to be noted that the composition of the coating layer 3 at respective portions thereof may have uniform distribution or non-uniform distribution. For example, the contents of the constituents of the coating layer 3 may be gradually changed in the thickness direction thereof, that is, graded materials may be used.

Further, although the coating layer 3 of the example shown in the drawing is formed on the entire surface of the base 2, it is sufficient for the coating layer 3 to be formed on at least a part of the base 2.

In accordance with the surface treatment method as described above, the ornamental part 1A can be obtained.

The ornamental part 1A of the present invention means various parts or articles having ornament, and examples of them include interior decorations such as bibelots; exterior decorations; adornm; external parts of timepieces such as timepiece-cases, timepiece-straps, timepiece-faces (dials), hands for timepieces, and the like; internal parts of timepieces such as base plates of movements; wheels; bearings; weights,

and the like; accessories such as glasses, tiepins, cuff buttons, finger rings, necklaces, bracelets, broaches, pendants, ear rings, pierces, and the like; lighters, and lighter cases; athletic goods such as golf clubs; memorial plates; panels; cups; various mechanical parts such as housings; various containers; and the like. Among these parts and articles, the present invention is particularly preferably applied to external parts of watches. This is because the external parts of timepieces are required to have aesthetic appearances for ornamentals as well as durability, corrosion resistance and anti-abrasiveness as commodities, and the surface treatment method of the present invention can satisfy all of these requirements.

Hereinbelow, a description will be made with regard to a second embodiment of the surface treatment method of the present invention and an ornamental part produced by the method.

Fig. 2 is a cross-sectional view which shows the surface treatment method of the second embodiment of the present invention and an ornamental part produced by the method.

In this connection, it is to be noted that the following description concerning the surface treatment method of the second embodiment and the ornamental part produced by the method is mainly focused to the different points between the first and second embodiments, and a description to the common points therebetween is omitted.

As shown in Fig. 2, the surface treatment method of this second embodiment includes the steps of forming a primary layer 40 on at least a part (Fig. 2a) of the surface of a base 2 (Fig. 2b) and forming a coating layer 3 made of a stainless steel on at least a part of the surface of the primary layer 40 by means of a dry plating method (Fig. 2c).

Namely, the surface treatment method of the second embodiment is the same as that of the first embodiment excepting that the primary layer 40 is formed on at least a part of the surface of the base 2 before the formation of the coating layer 3.

Hereinbelow, a detailed description will be made with regard to the primary layer 40.

<Primary Layer>

The primary layer 40 functions as a buffer layer which buffers the potential difference between the base 2 and the coating layer 3, for example. Thereby, it becomes possible to effectively prevent corrosion from being caused by the potential difference between the base 2 and the coating layer 3, that is corrosion caused by the contact of the different kinds of metals.

Further, the primary layer 40 may have function for improving the adhesion between the base 2 and the coating layer 3 as well as function for repairing holes or flaws of the base 2 by leveling.

Examples of the method for forming the primary layer 40 include wet plating methods such as electrolytic plating, immersion plating, electroless plating and the like; chemical vapor deposition such as thermal CVD, plasma CVD, laser CVD, and the like; dry plating method such as vacuum evaporation, sputtering, ion plating, and the like; thermal spraying; and bonding of metal foil; and the like. Among these methods, the wet plating method and dry plating method are particularly preferred.

By using the wet plating method or dry plating method as the method for forming the primary layer 40, the primary layer

40 formed can have especially excellent adhesion with the base 2. As a result, the obtained ornamental part 1B can have especially excellent durability.

Further, the primary layer 40 may be in the form of a film, in particular a passive state film, which is formed by performing a chemical treatment onto the surface of the base 2. Examples of such chemical treatment include oxidation treatment, nitrization treatment, chromate treatment, carbonization treatment, acid dipping, acid electrolyte treatment, alkaline dipping, alkaline electrolyte treatment, and the like.

The standard potential of the primary layer 40 is preferably set to be a value between the standard potential of the base 2 and the standard potential of the coating layer 3. Namely, it is preferred that the primary layer 40 is formed of a material of which standard potential lies in the range between the standard potential of the base 2 and the standard potential of the coating layer 3. This makes it possible to effectively prevent corrosion from being caused by the potential difference between the base 2 and the coating layer 3, that is corrosion caused by the contact of the difference metals

Example of the constituent material of the primary layer 40 include metals such as Ni, Cu, Au, Pd, Sn, Zn, Ag, In, Co, Ti, Fe, Al, Cr, Ir and the like; alloys containing at least one of the above-mentioned metal materials; metal compounds formed of at least one of the above-mentioned metal materials; a mixture of two or more of these materials. Examples of the metal compound include metallic oxide, metallic nitride, metallic carbide, and the like.

Further, it is preferred that the constituent material of the primary layer 40 includes at least one of the constituent material of the base 2 and the constituent material of the

coating layer 3. This makes it possible to improve the adhesion between the base 2 and the coating layer 3.

The average thickness of the primary layer 40 is not particularly limited to a specific value, but it should preferably lie in the range of 0.1 - 20.0 μm , and more preferably lie in the range of 0.5 - 10.0 μm .

If the average thickness of the primary layer 40 is less than the above-mentioned lower limit value, there is a possibility that the effect of the provision of the primary layer 40 is not fully exhibited.

On the other hand, if the average thickness of the primary layer 40 exceeds the above-mentioned upper limit value, there is tendency that dispersion in the thickness at various portions of the primary layer 40 becomes large. Further, the internal stress of the primary layer becomes high, thereby leading to the case that cracks are liable to occur.

As described above, by forming the primary layer 40 on the surface of the base 2, the adhesion between the base 2 and the coating layer 3 as well as the corrosion resistance of the ornamental part 1B become more excellent. As a result, the ornamental part 1B can have especially excellent durability.

In this regard, it is to be noted that although in the example shown in the drawing the primary layer 40 is formed on the entire surface of the base 2, it is sufficient that the primary layer 40 is formed on at least a part of the surface of the base 2.

Further, it is to be noted that the composition of the primary layer 40 at respective portions thereof may have uniform distribution or non-uniform distribution. For example, the contents of the constituents of the primary layer 40 may be

gradually changed in the thickness direction thereof, that is, graded materials may be used.

Furthermore, the primary layer 40 is not limited to one that functions as a buffer layer. For example, the primary layer 40 may have another function that prevents corrosion from being caused during storage, that is during the time until the step of forming the coating layer 3.

Next, a description will be made with regard to a third embodiment of the surface treatment method of the present invention and an ornamental part produced by the method.

Fig. 3 is a cross-sectional view which shows the surface treatment method of the third embodiment of the present invention and an ornamental part produced by the method.

In this connection, it is to be noted that the following description concerning the surface treatment method of the third embodiment and the ornamental part produced by the method is mainly focused to the different points from the first and second embodiments, and a description for the common points therebetween is omitted.

As shown in Fig. 3, the surface treatment method of this third embodiment includes the steps of forming a first primary layer 41, a second primary layer 42 and a third primary layer 43 successively on at least a part (Fig. 3a) of the surface of a base 2 (Fig. 3b, 3c, 3d) and forming a coating layer 3 made of a stainless steel on at least a part of the surface of the third primary layer 43 by means of a dry plating method (Fig. 3e).

Namely, the surface treatment method of the third embodiment is the same as that of the first embodiment excepting that the first primary layer 41, the second primary layer 42

and the third primary layer 43 are formed successively in this order on at least a part of the surface of the base 2 before the formation of the coating layer 3.

Hereinbelow, a detailed description will be made with regard to the first primary layer 41, the second primary layer 42 and the third primary layer 43, respectively.

<First Primary Layer>

The first primary layer 41 is formed on the surface of the base 2.

The first primary layer 41 has a function for improving the adhesion between the base 2 and the second primary layer 42 as well as a function for repairing holes or flaws of the base 2 by leveling.

Examples of the method for forming the first primary layer 41 include wet plating method such as electrolytic plating, immersion plating, electroless plating and the like; chemical vapor deposition such as thermal CVD, plasma CVD, laser CVD, and the like; dry plating method such as vacuum evaporation, sputtering, ion plating, and the like; thermal spraying; bonding of metal foil; and chemical treatment such as oxidation treatment, nitrization treatment, and the like against the surface of the base 2. Among these methods, the wet plating method and dry plating method are particularly preferred.

By using the wet plating method or dry plating method as the method for forming the first primary layer 41, the first primary layer 41 formed can have especially excellent adhesion against the base 2. As a result, the obtained ornamental part 1C can have especially excellent durability.

Example of the constituent material of the first primary

layer 41 include metals such as Cu, Sn, Ni, Zn, Fe, In, Co, Al and the like; alloys containing at least one of the above-mentioned metal materials; metal compounds formed of at least one of the above-mentioned metal materials; a mixture of two or more of these materials. Examples of the metal compound include metallic oxide, metallic nitride, metallic carbide, and the like.

Further, it is preferred that the constituent material of the first primary layer 41 includes at least one of the constituent material of the base 2 and the constituent material of the second primary layer 42. This makes it possible to further improve the adhesion between the base 2 and the primary layer 42.

The average thickness of the first primary layer 41 is not particularly limited to a specific value, but it should preferably lie in the range of 0.1 - 20.0 μm , and more preferably lie in the range of 0.5 - 10.0 μm .

If the average thickness of the first primary layer 41 is less than the above-mentioned lower limit value, there is a possibility that the effect of the provision of the first primary layer 41 is not fully exhibited.

On the other hand, if the average thickness of the first primary layer 41 exceeds the above-mentioned upper limit value, there is tendency that dispersion in the thickness at various portions of the first primary layer 41 becomes large. Further, the internal stress of the first primary layer 41 becomes high, thereby leading to the case that cracks are liable to occur.

In this regard, it is to be noted that although in the example shown in the drawing the first primary layer 41 is formed on the entire surface of the base 2, it is sufficient that the first primary layer 41 is formed on at least a part of the surface

of the base 2.

Further, it is to be noted that the composition of the first primary layer 41 at respective portions thereof may have uniform distribution or non-uniform distribution. For example, the contents of the constituents of the first primary layer 41 may be gradually changed in the thickness direction thereof, that is, graded materials may be used.

<Second Primary Layer>

Next, the second primary layer 42 is formed on the surface of the first primary layer 41.

The second primary layer 42 functions as a buffer layer which buffers the potential difference between one surface thereof, that is the first primary layer 41 and the opposite surface thereof, that is the third primary layer 43, for example. Thereby, it becomes possible to effectively prevent corrosion from being caused by the potential difference between the first primary layer 41 and the third primary layer 43, that is corrosion caused by the contact of the different kinds of metals.

Examples of the method for forming the second primary layer 42 include wet plating method such as electrolytic plating, immersion plating, electroless plating and the like; chemical vapor deposition such as thermal CVD, plasma CVD, laser CVD, and the like; dry plating method such as vacuum evaporation, sputtering, ion plating, and the like; thermal spraying; bonding of metal foil; and chemical treatment such as oxidation treatment, nitridization treatment, and the like against the surface of the first primary layer 41. Among these methods, the wet plating method and dry plating method are particularly preferred.

By using the wet plating method or dry plating method as the method for forming the second primary layer 42, the second primary layer 42 formed can have especially excellent adhesion against the first primary layer 41. As a result, the obtained ornamental part 1C can have especially excellent durability.

The standard potential of the second primary layer 42 is preferably set to be a value between the standard potential of the first primary layer 41 and the standard potential of the third primary layer 43. Namely, it is preferred that the second primary layer 42 is formed of a material of which standard potential lies in the range between the standard potential of the first primary layer 41 and the standard potential of the second primary layer 43. This makes it possible to effectively prevent corrosion from being caused by the potential difference between the first primary layer 41 and the third primary layer 43, that is corrosion caused by the contact of the different kinds of metals

Example of the constituent material of the second primary layer 42 include metals such as Cu, Sn, Zn, Fe, In, Ag, Au, Pd, Ti, Cr and the like; alloys containing at least one of the above-mentioned metal materials; metal compounds formed of at least one of the above-mentioned metal materials; a mixture of two or more of these materials. Examples of the metal compound include metallic oxide, metallic nitride, metallic carbide, and the like.

Further, it is preferred that the constituent material of the second primary layer 42 includes at least one of the constituent material of the first primary layer 41 and the constituent material of the third primary layer 43. In other words, it is preferred that the adjacent two primary layers are formed of materials containing the same or common element. This makes it possible to further improve the adhesion between the adjacent two primary layers. In particular, when the

above-mentioned same element is Cu, the adhesion between the two adjacent primary layers becomes especially excellent.

The average thickness of the second primary layer 42 is not particularly limited to a specific value, but it should preferably lie in the range of 0.1 - 20.0 μm , and more preferably lie in the range of 0.5 - 10.0 μm .

If the average thickness of the second primary layer 42 is less than the above-mentioned lower limit value, there is a possibility that the effect of the provision of the second primary layer 42 is not fully exhibited.

On the other hand, if the average thickness of the second primary layer 42 exceeds the above-mentioned upper limit value, there is tendency that dispersion in the thickness at various portions of the second primary layer 42 becomes large. Further, the internal stress of the second primary layer 42 becomes high, thereby leading to the case that cracks are liable to occur.

In this regard, it is to be noted that although in the example shown in the drawing the second primary layer 42 is formed on the entire surface of the first primary layer 41, it is sufficient that the second primary layer 42 is formed on at least a part of the surface of the first primary layer 41.

Further, it is also to be noted that the composition of the second primary layer 42 at respective portions thereof may have uniform distribution or non-uniform distribution. For example, the contents of the constituents of the second primary layer 42 may be gradually changed in the thickness direction thereof, that is, graded materials may be used.

<Third Primary Layer>

The third primary layer 43 is formed on the second primary

layer 42.

The third primary layer 43 has a function for improving the adhesion between the second primary layer 42 and the coating layer 3 as well as a function for preventing corrosion from being caused during storage, that is during the time until the step of forming the coating layer 3 is carried out.

Examples of the method for forming the third primary layer 43 include wet plating method such as electrolytic plating, immersion plating, electroless plating and the like; chemical vapor deposition such as thermal CVD, plasma CVD, laser CVD, and the like; dry plating method such as vacuum evaporation, sputtering, ion plating, and the like; thermal spraying; bonding of metal foil; and chemical treatment such as oxidation treatment, nitridization treatment, and the like against the surface of the second primary layer 42. Among these methods, the wet plating method and dry plating method are particularly preferred.

By using the wet plating method or dry plating method as the method for forming the third primary layer 43, the third primary layer 43 formed can have especially excellent adhesion against the second primary layer 42. As a result, the obtained ornamental part 1C can have especially excellent durability.

Example of the constituent material of the third primary layer 43 include metals such as Ni, Au, Pd, Ag, Fe, In, Ti, Cr, Sn, Cu, Pt, Rh, Ru and the like; alloys containing at least one of the above-mentioned metal materials; metal compounds formed of at least one of the above-mentioned metal materials; a mixture of two or more of these materials. Examples of the metal compound include metallic oxide, metallic nitride, metallic carbide, and the like.

Further, it is preferred that the constituent material

of the third primary layer 43 includes at least one of the constituent material of the second primary layer 42 and the constituent material of the coating layer 3. This makes it possible to further improve the adhesion against the second primary layer 42 and the coating layer 3.

The average thickness of the third primary layer 43 is not particularly limited to a specific value, but it should preferably lie in the range of 0.1 - 20.0 μm , and more preferably lie in the range of 1.0 - 3.0 μm .

If the average thickness of the third primary layer 43 is less than the above-mentioned lower limit value, there is a possibility that the effect of the provision of the third primary layer 43 is not fully exhibited.

On the other hand, if the average thickness of the third primary layer 43 exceeds the above-mentioned upper limit value, there is tendency that dispersion in the thickness at various portions of the third primary layer 43 becomes large. Further, the internal stress of the third primary layer 43 becomes high, thereby leading to the case that cracks are liable to occur.

In this regard, it is to be noted that although in the example shown in the drawing the third primary layer 43 is formed on the entire surface of the second primary layer 42, it is sufficient that the third primary layer 43 is formed on at least a part of the surface of the second primary layer 42.

Further, it is also to be noted that the composition of the third primary layer 43 at respective portions thereof may have uniform distribution or non-uniform distribution. For example, the contents of the constituents of the third primary layer 43 may be gradually changed in the thickness direction thereof, that is, graded materials may be used.

As described above, by laminating the first primary layer 41, the second primary layer 42 and the third primary layer 43 on the surface of the base 2 in this order, the adhesion between the base 2 and the coating layer 3 and the corrosion resistance of the ornamental part 1C become more excellent. As a result, the ornamental part 1C can have especially excellent durability.

However, it is to be noted that first primary layer 41, the second primary layer 42 and the third primary layer 43 are not limited to those having the functions as described above, and these layer may have other functions.

Hereinbelow, a description will be made with regard to a fourth embodiment of the surface treatment method of the present invention and an ornamental part produced by the method.

Fig. 4 is a cross-sectional view which shows the surface treatment method of the fourth embodiment of the present invention and an ornamental part produced by the method.

In this connection, it is to be noted that the following description concerning the surface treatment method of the fourth embodiment and the ornamental part produced by the method is mainly focused to the different points from the first, second and third embodiments, and a description for the common points therebetween is omitted.

As shown in Fig. 4, the surface treatment method of this fourth embodiment includes the steps of forming a first primary layer 41, a second primary layer 42 and a third primary layer 43 successively on at least a part (Fig. 4a) of the surface of a base 2 (Fig. 4b, 4c, 4d), forming a coating layer 3 made of a stainless steel on at least a part of the surface of the third primary layer 43 by means of a dry plating method (Fig. 4e), forming a masking coating 5 on a part of the coating layer 3

(Fig. 4f), removing the coating layer 3 provided on a part where the masking coating 5 is not provided by using a releasing agent (Fig. 4g), and removing the masking coating 5 (Fig. 4h).

Namely, the surface treatment method of the fourth embodiment is the same as that of the third embodiment excepting that this method further includes the steps of forming a masking coating 5 on a part of the coating layer 3 (Fig. 4f), removing the coating layer 3 provided on a part where the masking coating 5 is not provided by using a peeling agent (Fig. 4g), and removing the masking coating 5 (Fig. 4h).

<Coating with Masking Coating>

After the formation of the coating layer 3, a masking coating 5 is coated on a part of the surface of the coating layer 3 (Fig. 4f). This masking coating 5 functions as a mask that protects the part of the coating layer 3 coated with the masking coating 5 during the step for removing the coating layer 3 which will be described later.

Any types of masking coatings can be used as the masking coating 5 if they have a function that protects the part of the coating layer 3 coated with the masking coating 5 during the step for removing the coating layer 3. However, masking coatings which will be easily removed in the later masking coating removal step (described later) are preferred.

Examples of materials for the masking coating 5 include resin materials such as acryl based resins, polyimide based resins, polysulfone based resins, epoxy resins, fluorine based resins, and the like; and metal materials such as Au, Ni, Pd, Cu, Ag, Ti, Cr, and the like.

The method of forming the masking coating 5 is not particularly limited to a specific method, and various methods

can be used. Examples of the methods include dipping; coating (painting) such as brushing, spraying, electrostatic coating, electrodeposition coating, and the like; wet plating method such as electrolytic plating, immersion plating, electroless plating and the like; chemical vapor deposition such as thermal CVD, plasma CVD, laser CVD, and the like; dry plating method such as vacuum evaporation, sputtering, ion plating, and the like; thermal spraying; and the like.

The average thickness of the masking coating 5 is not particularly limited to a specific value, but it should preferably lie in the range of 100 - 2000 μm , and more preferably lie in the range of 500 - 1000 μm .

If the average thickness of the masking coating 5 is less than the above-mentioned lower limit value, there is tendency that pinholes are liable to be produced. This leads to the case that a part of the coating layer 3 coated with the masking coating 5 is melted or peeled off during the step for removing the coating layer 3 described later, and therefore the aesthetic appearance of the obtained ornamental part 1D is lowered.

On the other hand, if the average thickness of the masking coating 5 exceeds the above-mentioned upper limit value, there is tendency that dispersion in the thickness at various portions of the masking coating 5 becomes large. Further, the internal stress of the masking coating 5 becomes high, thereby leading to the case that the adhesion between the masking coating 5 and the coating layer 3 is lowered and cracks are liable to occur.

Furthermore, it is preferred that the masking coating 5 is transparent. This makes it possible to visually observe the condition of the adhesion with the coating layer 3 from the outside thereof.

The masking coating 5 is not limited to one that is formed

on the surface of the coating layer 3 such that it is directly formed into a final pattern. For example, a masking coating 5 having a final pattern can be formed by coating the substantially entire surface of the coating layer 3 with the constituent material of the masking coating 5 and then removing a part of the coating.

For removing a part of the masking coating 5 which is coated on the substantially entire surface of the coating layer 3, a method for irradiating a laser beam to a part of the masking coating 5 from which the masking coating should be removed. Examples of the laser that can be used for this purpose include gas lasers such as Ne-He laser, Ar laser, CO₂ laser, and the like; ruby laser; semiconductor laser; YAG laser; glass laser; YVO₄ laser; and the like.

<Removal of Coating Layer>

Next, the coating layer 3 provided on the portion which is not coated with the masking coating 5 is removed (Fig. 4g).

The removal of the coating layer 3 is carried out using a peeling agent by which the coating layer 3 can be removed but the masking coating 5 is not substantially melted or peeled off.

The peeling agent used for removing the coating layer 3 is not limited to a specific one, and any types of peeling agents can be used if they can remove the coating layer 3 but do not substantially melt or peel off the masking coating 5. However, peeling agents of fluid type such as liquid type or gas type are preferred, and among them a liquid type is particularly preferred. This makes it possible to carry out the removal of the coating layer 3 easily and reliably.

As for the peeling agent, one kind or a mixture of two or more kinds selected from the following inorganic solvents

and organic solvents can be used, for example.

Examples of the inorganic solvent include nitric acid, sulfuric acid, ammonia, hydrogen peroxide, water, carbon disulfide, carbon tetrachloride, and the like.

Examples of the organic solvents include ketone-based solvents such as methyl ethyl ketone (MEK), acetone, diethyl ketone, methyl isobutyl ketone (MIBK), methyl isopropyl ketone (MIPK), cyclohexanone, and the like; alcohol-based solvents such as methanol, ethanol, isopropanol, ethylene glycol, diethylene glycol (DEG), glycerin, and the like; ether-based solvents such as diethyl ether, diisopropyl ether, 1,2-dimethoxyethane (DME), 1,4-dioxane, tetrahydrofuran (THF), tetrahydropyran (THP), anisole, diethylene glycol dimethyl ether (diglyme), and the like; cellosolve-based solvents such as methyl cellosolve, ethyl cellosolve, phenyl cellosolve, and the like; aliphatic hydrocarbon-based solvent such as hexane, pentane, heptane, cyclohexane, and the like; aromatic hydrocarbon-based solvents such as toluene, xylene, benzene, and the like; aromatic heterocyclic compound-based solvents such as pyridine, pyrazine, furan, pyrrole, thiophene, and the like; amide-based solvents such as N,N-dimethylformamide (DMF), N,N-dimethylacetamide (DMA), and the like; halogen compound-based solvents such as dichloromethane, chloroform, 1,2-dichloroethane, and the like; ester-based solvents such as ethyl acetate, methyl acetate, ethyl formate, and the like; sulfur compound-based solvents such as dimethyl sulfoxide (DMSO), sulfolane, and the like; nitrile-based solvents such as acetonitrile, propionitrile, and the like; and organic acid-based solvents such as formic acid, acetic acid, trichloroacetic acid, trifluoroacetic acid, hydrogen fluoride and the like.

In addition, the peeling agent may be a mixture of any one of the above-mentioned solvents and any one of the

followings, that is, acidic materials such as nitric acid, sulfuric acid, hydrogen chloride, hydrogen fluoride, phosphoric acid, and the like; alkaline materials such as sodium hydroxide, potassium hydroxide, lithium hydroxide, calcium hydroxide, magnesium hydroxide, ammonia, and the like; oxidants such as potassium permanganate (KMnO_4), manganese dioxide (MnO_2), potassium dichromate ($\text{K}_2\text{Cr}_2\text{O}_7$), ozone, concentrated sulfuric acid, nitric acid, chlorinated lime, hydrogen peroxide, chinone kind, and the like; and reducing agent such as sodium thiosulfate ($\text{Na}_2\text{S}_2\text{O}_3$), hydrogen sulfide, hydrogen peroxide, hydroquinone kind.

As for the method for removing the coating layer 3, a method for spraying a peeling agent, a method for dipping into a peeling agent of a liquid state, a method of electrolyzing the coating layer 3 under the condition that it is immersed in the liquid state peeling agent, and the like can be mentioned. Among these methods, the method of electrolyzing the coating layer 3 under the condition that it is immersed in the liquid state peeling agent is particularly preferred. By using such a method, it becomes possible to carry out the removal of the coating layer 3 more readily and reliably.

When the removal of the coating layer 3 is carried out under the condition that it is immersed in the liquid state peeling agent, the temperature of the peeling agent is not particularly limited to a specific value, but it should preferably lie in the range of 15 to 100°C, more preferably lie in the range of 30 to 80°C, and most preferably lie in the range of 40 to 60°C.

If the temperature of the peeling agent is lower than the above-mentioned lower limit value, it takes a long time to sufficiently remove a part of the coating layer 3 on which the masking coating 5 is not provided depending on the thickness of the coating layer 3 and the like, thus leading to the case

that the productivity of the ornamental part 1D is lowered.

On the other hand, if the temperature of the peeling agent is higher than the above-mentioned upper limit, an amount of volatilization of the peeling agent becomes large depending on the vapor pressure and the boiling point of the peeling agent, which shows tendency that an amount of the peeling agent required for removing the coating layer 3 becomes large.

Further, the immersing time into the peeling agent is not particularly limited to a specific value, but it should preferably lie in the range of 5 to 120 minutes, and more preferably lie in the range of 20 to 60 minutes.

If the immersing time into the peeling agent is less than the above-mentioned lower limit value, there is a case that it is difficult to sufficiently remove a part of the coating layer 3 on which the masking coating 5 is not provided depending on the thickness of the coating layer 3, the temperature of the peeling agent and the like.

On the other hand, if the immersing time into peeling agent exceeds the above-mentioned upper limit value, the productivity of the ornamental part 1D tends to be lowered.

<Removal of Masking Coating>

Thereafter, the masking coating 5 is removed, thereby obtaining the ornamental part 1D.

Various methods can be used to remove the masking coating 5, but it is preferred to use a masking coating removal agent by which the masking coating can be removed and substantially no damage is given to the base 2 and the coating layer 3.

By using such a masking coating removal agent, it is

possible to remove the masking coating 5 easily and reliably.

No particular limitation is imposed on the kind of the masking coating removal agent, but it is preferable to use a fluid type one such as a liquid state or gaseous state. Among them, a liquid type masking coating removal agent is especially preferred. By using such a masking coating removal agent, it becomes possible to remove the masking coating 5 more easily and reliably.

As for the masking coating removal agent, one kind or a mixture of two or more kinds selected from the following inorganic solvents and organic solvents can be used, for example.

Examples of the inorganic solvent include nitric acid, sulfuric acid, ammonia, hydrogen peroxide, water, carbon disulfide, carbon tetrachloride, and the like.

Examples of the organic solvents include ketone-based solvents such as methyl ethyl ketone (MEK), acetone, diethyl ketone, methyl isobutyl ketone (MIBK), methyl isopropyl ketone (MIPK), cyclohexanone, and the like; alcohol-based solvents such as methanol, ethanol, isopropanol, ethylene glycol, diethylene glycol (DEG), glycerin, and the like; ether-based solvents such as diethyl ether, diisopropyl ether, 1,2-dimethoxyethane (DME), 1,4-dioxane, tetrahydrofuran (THF), tetrahydropyran (THP), anisole, diethylene glycol dimethyl ether (diglyme), and the like; cellosolve-based solvents such as methyl cellosolve, ethyl cellosolve, phenyl cellosolve, and the like; aliphatic hydrocarbon-based solvent such as hexane, pentane, heptane, cyclohexane, and the like; aromatic hydrocarbon-based solvents such as toluene, xylene, benzene, and the like; aromatic heterocyclic compound-based solvents such as pyridine, pyrazine, furan, pyrrole, thiophene, and the like; amide-based solvents such as N,N-dimethylformamide (DMF),

N,N-dimethylacetamide (DMA), and the like; halogen compound-based solvents such as dichloromethane, chloroform, 1,2-dichloroethane, and the like; ester-based solvents such as ethyl acetate, methyl acetate, ethyl formate, and the like; sulfur compound-based solvents such as dimethyl sulfoxide (DMSO), sulfolane, and the like; nitrile-based solvents such as acetonitrile, propionitrile, and the like; and organic acid-based solvents such as formic acid, acetic acid, trichloroacetic acid, trifluoroacetic acid, and the like.

In addition, the peeling agent may be mixtures of the any one of the above-mentioned solvents and any one of the followings, that is, acidic materials such as nitric acid, sulfuric acid, hydrogen chloride, hydrogen fluoride, phosphoric acid, and the like; alkaline materials such as sodium hydroxide, potassium hydroxide, lithium hydroxide, calcium hydroxide, magnesium hydroxide, ammonia, and the like; oxidants such as potassium permanganate (KMnO_4), manganese dioxide (MnO_2), potassium dichromate ($\text{K}_2\text{Cr}_2\text{O}_7$), ozone, concentrated sulfuric acid, nitric acid, chlorinated lime, hydrogen peroxide, chinone kind, and the like; and reducing agent such as sodium thiosulfate ($\text{Na}_2\text{S}_2\text{O}_3$), hydrogen sulfide, hydrogen peroxide, hydroquinone kind.

As for the method for removing the masking coating 5, a method for spraying a masking coating removal agent, a method for dipping into a masking coating removal agent of a liquid state, a method of electrolyzing the masking coating 5 under the condition that it is immersed in the liquid state masking coating removal agent, and the like can be mentioned. Among these methods, the method of electrolyzing the masking coating 5 under the condition that it is immersed in the liquid state masking coating removal agent is particularly preferred. By using such a method, it becomes possible to remove the masking coating 5 more readily and reliably.

When the removal of the masking coating 5 is carried out under the condition that it is immersed in the liquid state masking coating removal agent, the temperature of the masking coating removal agent is not particularly limited to a specific value, but it should preferably lie in the range of 15 to 100°C, and more preferably lie in the range of 30 to 50°C.

If the temperature of the masking coating removal agent is lower than the above-mentioned lower limit value, it takes a long time to sufficiently remove the masking coating 5 depending on the thickness of the masking coating 5 and the like, thus leading to the case that the productivity of the ornamental part 1D is lowered.

On the other hand, if the temperature of the masking coating removal agent is higher than the above-mentioned upper limit, an amount of volatilization of the masking coating removal agent becomes large depending on the vapor pressure and the boiling point of the masking coating removal agent, which shows tendency that an amount of the masking coating removal agent required for removing the masking coating 5 becomes large.

Further, the immersing time into the masking coating removal agent is not particularly limited to a specific value, but it should preferably lie in the range of 5 to 60 minutes, and more preferably lie in the range of 5 to 30 minutes.

If the immersing time is less than the above-mentioned lower limit value, there is a case that it is difficult to sufficiently remove the masking coating 5 depending on the thickness of the masking coating 5, the temperature of the masking coating removal agent and the like.

On the other hand, if the immersing time into the masking coating removal agent exceeds the above-mentioned upper limit value, the productivity of the ornamental part 1D tends to be

lowered.

As described above, by removing a part of the coating layer 3, it becomes easy to carry out patterning of the coating layer 3 into a predetermined shape.

Further, by removing a part of the coating layer 3, it becomes possible to form a pattern such as a relief formed from the portions from which the coating layer 3 are removed and the portions in which the coating layer 3 still remain. Further, it also becomes possible to obtain more distinct color difference. With these results, the aesthetic appearance of the obtained ornamental part 1D becomes more excellent.

In the foregoing, the preferred embodiments of the surface treatment method of the present invention and the ornamental parts produced by the method have been described. However, the present invention is not limited thereto.

For example, although the second embodiment is formed with one primary layer and the third embodiment is formed with three primary layers comprised of the first primary layer 41, the second primary layer 42 and the third primary layer 43, two or four or more primary layers may be formed. In these cases, it is preferred that one of the primary layers has a function that relieves the potential difference between the one surface of the primary layer and the other surface thereof.

Further, it is also preferred that, even in the case where the two or four or more primary layers are formed as described above, the adjacent two layers are formed of the materials containing the same element with each other. This makes it possible to further improve the adhesion between the adjacent two layers. Furthermore, if the same element is Cu, the adhesion between the adjacent two layers becomes especially excellent.

Furthermore, in the present invention, a part of the ornamental part may be provide with a protective layer for improving anti-rust, anti-contamination, anti-dim, and anti-damage effects and the like by imparting corrosion resistance property, weather resistance property, water proof property, oil proof property, wear resistance property, anti-discoloration property, and the like to that part.

Moreover, in the fourth embodiment, although a part of the coating layer 3 is removed using the peeling agent, a part of the primary layer at that portion, that is a part of the first primary layer 41, the second primary layer 42 and the third primary layer 43 may be removed together with the coating layer 3.

Hereibelow, a description will be made with regard to the actual examples of the present invention.

1. Production of Ornamental Parts

EXAMPLE 1

A wristwatch case as an ornamental part was produced by being subjected to the following surface treatment.

First, a base having a shape of a wristwatch case was formed by compaction molding using acrylonitrile-butadiene-styrene resin, and then necessary portions thereof were cut and ground.

Next, this base was subjected to cleaning. The cleaning of the base was carried out through alkaline electrolytic degreasing for 30 seconds and subsequent alkaline immersion decreasing for 30 seconds. Then, after neutralization for ten seconds, the base was washed by water for ten seconds and then

it was washed by pure water for ten seconds.

Onto the surface of the base which had been subjected to the cleaning as described above, a coating layer made of a stainless steel was formed.

The formation of the coating layer was carried out by ion plating as described below.

First, the base was mounted into an ion plating apparatus. Then, the air inside the ion plating apparatus was discharged so that the internal pressure was reduced into 2×10^{-5} Torr while the inside of the apparatus was being heated.

Thereafter, the air inside the ion plating apparatus was further discharged so that the internal pressure was reduced to 2×10^{-6} Torr, and then a bombardment treatment was carried out for five minutes under the ambient atmosphere of argon gas having a flow rate of 470ml/min.

Subsequently, the internal pressure of the ion plating apparatus was raised to a reduced pressure of 6×10^{-4} Torr, and then the ion plating process was carried out using SUS444 as a target under the condition of ionization voltage of 40V and ionization current of 40A to form a coating layer made from the stainless steel, thereby obtaining an ornamental part. In this case, the argon gas was used for the ambient atmospheric gas within the ion plating apparatus.

The average thickness of the thus formed coating layer was 1.0 μm . The thickness of the coating layer was measured in accordance with the coating thickness measurement by microscope determined by JIS H 5821.

In addition, the surface roughness R_{max} determined by JIS B 0601 was measured for each of the base and the obtained

ornamental part.

The surface roughness $R_{\max}$ of a portion of the base where the cutting and grinding had been carried out was $1.6 \mu\text{m}$. However, after the formation of the coating layer, the corresponding portion was formed into a mirror surface having the surface roughness $R_{\max}$ of $0.3 \mu\text{m}$.

On the other hand, the portion of the base where no cutting and grinding had been carried out had been formed into a satin finished surface having the surface roughness $R_{\max}$ of $4.5 \mu\text{m}$. However, after the formation of the coating layer, the corresponding portion was formed into a semi-mirror surface having the surface roughness $R_{\max}$ of $0.9 \mu\text{m}$.

As described above, it has been found that the surface was smoothed due to the formation of the coating layer by ion plating.

EXAMPLE 2

A watch case as an ornamental part was produced in the same manner as EXAMPLE 1 mentioned above excepting that the base was made of Ti and manufactured by metal injection molding (MIM).

The base made of Ti was manufactured as follows.

First, a Ti powder having the mean particle size of $52 \mu\text{m}$ which was produced by gas atomizing method was prepared.

A base material comprised of 75 vol% of the Ti powder, 8 vol% of polyethylene, 7 vol% of polypropylene and 10 vol% of paraffin was kneaded. A kneader was used for kneading the base material. Further, the temperature of the base material at the kneading process was 60°C .

Thereafter, the kneaded material thus obtained was milled, and then classified into pellets having the mean particle diameter of 3mm. By using thus obtained pellets, metal injection molding (MIM) was carried out by an injection molding machine, thereby obtaining a green body having a shape of the watch case. In this step, the size and shape of the green was determined taking into account shrinkage which will occur in the subsequent debinding process and the sintering process. The molding conditions in this injection molding were as follows: the mold temperature was 40°C, the injection pressure was 80kgf/cm², the injection time was 20 seconds, and the cooling time was 40 seconds.

Next, the green body was subjected to a debinding treatment using a debinding furnace to obtain a brown body. This debinding treatment was carried out in the argon gas atmosphere of 1×10^{-3} Torr, in which the brown body was being placed at a temperature of 80°C for one hour, and then the temperature was raised to 400°C with a temperature raising rate of 10°C per one hour. During this heating treatment, the weight of the sample was repeatedly measured, and at the time when the decrease of the weight of the sample could not be detected, the debinding treatment was terminated.

Next, thus obtained brown body was sintered in a sintering furnace to obtain a base. The sintering was carried out in the argon gas atmosphere of 1×10^{-5} to 1×10^{-6} Torr so that the brown body was being subjected to the heating treatment at a temperature of 900 to 1100°C for six hours.

Further, the surface roughness $R_{\max}$ determined by JIS B 0601 was measured for each of the base and the obtained ornamental part.

The surface roughness $R_{\max}$ of a portion of the base where

the cutting and grinding had been carried out was $1.2\text{ }\mu\text{m}$. However, after the formation of the coating layer, the corresponding portion was formed into a mirror surface having the surface roughness R_{max} of $0.25\text{ }\mu\text{m}$.

On the other hand, the portion of the base where no cutting and grinding had been carried out had been formed into a satin finished surface having the surface roughness R_{max} of $6.0\text{ }\mu\text{m}$. However, after the formation of the coating layer, the corresponding portion was formed into a semi-mirror surface having the surface roughness R_{max} of $1.1\text{ }\mu\text{m}$.

As described above, it has been found that the surface was smoothed due to the formation of the coating layer by ion plating.

EXAMPLE 3

A dial for a wristwatch as an ornamental part was produced by being subjected to the following surface treatment.

First, a base having a shape of a dial for a wristwatch was produced using a powder of alumina (Al_2O_3) by means of a power metallurgy sintering, and then necessary portions thereof were cut and ground.

Next, this base was subjected to cleaning. The cleaning of the base was carried out through alkaline electrolytic degreasing for 30 seconds and subsequent alkaline immersion decreasing for 30 seconds. Then, after neutralization for ten seconds, the base was washed by water for ten seconds and then it was washed by pure water for ten seconds.

Onto the surface of the base which had been subjected to the cleaning as described above, a coating layer made of a stainless steel was formed.

The formation of the coating layer was carried out by ion plating as described below.

First, the base was mounted into an ion plating apparatus. Then, the air inside the ion plating apparatus was discharged so that the internal pressure was reduced to 2×10^{-5} Torr while the inside of the apparatus was being heated.

Thereafter, the air inside the ion plating apparatus into was further discharged so that the internal pressure was reduced to 2×10^{-6} Torr, and then a bombardment treatment was carried out for five minutes under the ambient atmosphere of argon gas having a flow rate of 470ml/min.

Subsequently, the internal pressure of the ion plating apparatus was raised to a reduced pressure of 6×10^{-4} Torr, and then the ion plating process was carried out using SUS444 as a target under the condition of ionization voltage of 40V and ionization current of 40A to form a coating layer made from the stainless steel, thereby obtaining an ornamental part. In this case, the argon gas was used for the ambient atmospheric gas within the ion plating apparatus.

The average thickness of the thus formed coating layer was 1.0 μm . The thickness of the coating layer was measured in accordance with the coating thickness measurement by microscope determined by JIS H 5821.

EXAMPLE 4

A hand for a wristwatch as an ornamental part was produced by being subjected to the following surface treatment.

First, a base having a shape of a hand for a watch was produced using a Cu-Zn based alloy (alloy composition: 60wt%

of Cu and 40wt% of Zn) by means of casting, and then after the necessary portions thereof were cut and ground, a mirror finish processing was carried out thereto by means of a diamond cutter.

Next, this base was subjected to cleaning. The cleaning of the base was carried out through alkaline immersion decreasing for 30 seconds, and then, after neutralization for ten seconds, the base was washed by water for ten seconds and then it was washed by pure water for ten seconds.

Onto the surface of the base which had been subjected to the mirror finish processing, a primary layer made of Ni was formed.

The formation of the primary layer was carried out by wet plating under the following conditions: the temperature of the bath was 60°C, the current density was 3A/dm², and the plating time was 10 minutes.

The average thickness of the thus formed primary layer was 5 μm.

Next, the base on which the primary layer was laminated was subjected to cleaning. The cleaning of the base was carried out through alkaline electrolytic degreasing for 30 seconds and subsequent alkaline immersion decreasing for 30 seconds. Then, after neutralization for ten seconds, the base was washed by water for ten seconds and then it was washed by pure water for ten seconds.

After the cleaning, a coating layer made of a stainless steel was formed on the surface of the primary layer.

The formation of the coating layer was carried out by ion plating as described below.

First, the base having the primary layer was mounted into an ion plating apparatus. Then, the air inside the ion plating apparatus was discharged so that the internal pressure was reduced to 2×10^{-5} Torr while the inside of the apparatus was being heated.

Thereafter, the air inside the ion plating apparatus was further discharged so that the internal pressure was reduced to 2×10^{-6} Torr, and then a bombardment treatment was carried out for five minutes under the ambient atmosphere of argon gas having a flow rate of 470ml/min.

Subsequently, the internal pressure of the ion plating apparatus was raised to a reduced pressure of 6×10^{-4} Torr, and then the ion plating process was carried out using SUS316L as a target under the condition of ionization voltage of 40V and ionization current of 40A to form a coating layer made from the stainless steel, thereby obtaining an ornamental part. In this case, the argon gas was used for the ambient atmospheric gas within the ion plating apparatus.

The average thickness of the thus formed coating layer was 2.5 μm .

The thickness of each of the primary layer and the coating layer was measured in accordance with the coating thickness measurement by microscope determined by JIS H 5821.

EXAMPLE 5

A case for a wristwatch as an ornamental part was produced by being subjected to the following surface treatment.

First, a base made of aluminum and having a shape of the watch case was produced by means of casting, and then the necessary portions thereof were cut and ground.

Thereafter, the base was subjected to a hair line processing by grinding the surface of the base using the emery #180 as abrasives.

Next, a primary layer made of an aluminum oxide (Al_2O_3) was formed on the surface of the base to which the hair line processing had been carried out.

The formation of the primary layer was carried out by anodic oxidation method under the following conditions: the temperature of the bath was 30°C , the current density was $2\text{A}/\text{dm}^2$, and the time was 60 minutes.

The average thickness of the thus formed primary layer was $20\text{ }\mu\text{m}$.

Next, this primary layer was subjected to cleaning. The cleaning of the primary layer was carried out through alkaline immersion decreasing for 30 seconds, and then, after neutralization for ten seconds, the primary layer was washed by water for ten seconds and then it was washed by pure water for ten seconds.

Onto the surface of the thus formed primary layer, a coating layer made of a stainless steel was formed.

The formation of the coating layer was carried out by ion plating as described below.

First, the base having the primary layer was mounted into an ion plating apparatus. Then, the air inside the ion plating apparatus was discharged so that the internal pressure was reduced to 2×10^{-5} Torr while the inside of the apparatus was being heated.

Thereafter, the air inside the ion plating apparatus was further discharged so that the internal pressure was reduced to 2×10^{-6} Torr, and then a bombardment treatment was carried out for five minutes under the ambient atmosphere of argon gas having a flow rate of 470ml/min.

Subsequently, the internal pressure of the ion plating apparatus was raised to a reduced pressure of 6×10^{-4} Torr, and then the ion plating process was carried out using SUS444 as a target under the condition of ionization voltage of 40V and ionization current of 40A to form a coating layer made from the stainless steel, thereby obtaining an ornamental part. In this case, the argon gas was used for the ambient atmospheric gas within the ion plating apparatus.

The average thickness of the thus formed coating layer was 1.0 μm .

The thickness of each of the primary layer and the coating layer was measured in accordance with the coating thickness measurement by microscope determined by JIS H 5821.

EXAMPLE 6

A dial for a wristwatch as an ornamental part was produced by being subjected to the following surface treatment.

First, a base having a shape of a watch face was produced using a Cu-Zn based alloy (alloy composition: 60wt% of Cu and 40wt% of Zn) by means of casting, and then the necessary portions thereof were cut and ground.

Next, this base was subjected to cleaning. The cleaning of the base was carried out through alkaline electrolytic degreasing for 30 seconds and subsequent alkaline immersion degreasing for 30 seconds. Then, after neutralization for ten

seconds, the base was washed by water for ten seconds and then it was washed by pure water for ten seconds.

Onto the surface of the base which had been subjected to the cleaning described above, a first primary layer made of Cu was formed.

The formation of the first primary layer was carried out by wet plating under the following conditions: the temperature of the bath was 60°C, the current density was 3A/dm², and the plating time was 10 minutes.

The average thickness of the thus formed first primary layer was 5 µm.

Next, onto the surface of the first primary layer, a second primary layer made of a Cu - Sn based alloy was formed.

The formation of the second primary layer was carried out by wet plating under the following conditions: the temperature of the bath was 60°C, the current density was 3A/dm², and the plating time was 2 minutes.

The average thickness of the thus formed second primary layer was 3 µm.

Further, onto the surface of the second primary layer, a third primary layer made of a Ni - Sn based alloy (alloy composition: 80wt% of Ni and 20wt% of Sn) was formed.

The formation of the third primary layer was carried out by wet plating under the following conditions: the temperature of the bath was 60°C, the current density was 3A/dm², and the plating time was 10 minutes.

The average thickness of the thus formed third primary

layer was 3 μm .

Next, the base on which the first to third primary layers were laminated was subjected to cleaning. The cleaning was carried out through alkaline electrolytic degreasing for 30 seconds and subsequent alkaline immersion decreasing for 30 seconds. Then, after neutralization for ten seconds, the base with the primary layers was washed by water for ten seconds and then it was washed by pure water for ten seconds.

After the cleaning, a coating layer made of a stainless steel was formed on the surface of the third primary layer.

The formation of the coating layer was carried out by ion plating as described below.

First, the base having the first to third primary layers was mounted into an ion plating apparatus. Then, the air inside the ion plating apparatus was discharged so that the internal pressure was reduced to 2×10^{-5} Torr while the inside of the apparatus was being heated.

Thereafter, the air inside the ion plating apparatus was further discharged so that the internal pressure was reduced to 2×10^{-6} Torr, and then a bombardment treatment was carried out for five minutes under the ambient atmosphere of argon gas having a flow rate of 470ml/min.

Subsequently, the internal pressure of the ion plating apparatus was raised to a reduced pressure of 6×10^{-4} Torr, and then the ion plating process was carried out using SUS316L as a target under the condition of ionization voltage of 40V and ionization current of 40A to form a coating layer made from the stainless steel, thereby obtaining an ornamental part. In this case, the argon gas was used for the ambient atmospheric gas within the ion plating apparatus.

The average thickness of the thus formed coating layer was 2.5 μm .

The thickness of each of the first primary layer, the second primary layer, the third primary layer and the coating layer was measured in accordance with the coating thickness measurement by microscope determined by JIS H 5821.

EXAMPLE 7

A dial for a wristwatch as an ornamental part was produced by being subjected to the following surface treatment.

First, a base having a shape of the watch face was produced using a polycarbonate by means of injection molding, and then necessary portions thereof were cut and ground.

Next, this base was subjected to cleaning. The cleaning of the base was carried out through alkaline electrolytic degreasing for 30 seconds and subsequent alkaline immersion decreasing for 30 seconds. Then, after neutralization for ten seconds, the base was washed by water for ten seconds and then it was washed by pure water for ten seconds.

Then, a bombardment treatment was carried out for the surface of the base which was subjected to the cleaning mentioned above for five minutes under the reduced pressure of 2×10^{-6} Torr and the ambient atmosphere of argon gas having a flow rate of 470ml/min.

Next, onto the surface of the base which had been subjected to the bombardment treatment described above, a first primary layer made of Ni was formed.

The formation of the first primary layer was carried out

by electroless wet plating under the following conditions: the temperature of the bath was 60°C, the current density was 3A/dm², and the plating time was 5 minutes.

The average thickness of the thus formed first primary layer was 0.5 µm.

Next, onto the surface of the first primary layer, a second primary layer made of Cu was formed.

The formation of the second primary layer was carried out by electrolytic plating under the following conditions: the temperature of the bath was 60°C, the current density was 3A/dm², and the plating time was 15 minutes.

The average thickness of the thus formed second primary layer was 15 µm.

Further, onto the surface of the second primary layer, a third primary layer made of Ni was formed.

The formation of the third primary layer was carried out by wet plating under the following conditions: the temperature of the bath was 60°C, the current density was 3A/dm², and the plating time was 10 minutes.

The average thickness of the thus formed third primary layer was 10 µm.

Next, the base on which the first to third primary layers were laminated was subjected to cleaning. The cleaning was carried out through alkaline immersion decreasing for 30 seconds, and then, after neutralization for ten seconds, the base with the primary layers was washed by water for ten seconds and then it was washed by pure water for ten seconds.

After the cleaning, a coating layer made of a stainless steel was formed on the surface of the second primary layer.

The formation of the coating layer was carried out by ion plating as described below.

First, the base having the first to third primary layers was mounted into an ion plating apparatus. Then, the air inside the ion plating apparatus was discharged so that the internal pressure was reduced to 2×10^{-5} Torr while the inside of the apparatus was being heated.

Thereafter, the air inside the ion plating apparatus was further discharged so that the internal pressure was reduced to 2×10^{-6} Torr, and then a bombardment treatment was carried out for five minutes under the ambient atmosphere of argon gas having a flow rate of 470ml/min.

Subsequently, the internal pressure of the ion plating apparatus was raised to a reduced pressure of 6×10^{-4} Torr, and then the ion plating process was carried out using SUS316L as a target under the condition of ionization voltage of 40V and ionization current of 40A to form a coating layer made from the stainless steel, thereby obtaining an ornamental part. In this case, the argon gas was used for the ambient atmospheric gas within the ion plating apparatus.

The average thickness of the thus formed coating layer was 2.5 μm .

The thickness of each of the first primary layer, the second primary layer, the third primary layer and the coating layer was measured in accordance with the coating thickness measurement by microscope determined by JIS H 5821.

EXAMPLE 8

A case for a wristwatch as an ornamental part was produced by being subjected to the following surface treatment.

First, a base having a shape of the watch case was produced using Zn by means of casting, and then necessary portions thereof were cut and ground.

Next, the surface of the base was subjected to a satin finish processing. The satin finish processing was carried out by blasting beads of glass against the surface of the base with the pressure of 2kg/cm^2 .

Next, the base which had been subjected to the satin finish processing was subjected to cleaning. The cleaning of the base was carried out through alkaline electrolytic degreasing for 30 seconds and subsequent alkaline immersion degreasing for 30 seconds. Then, after neutralization for ten seconds, the base was washed by water for ten seconds and then it was washed by pure water for ten seconds.

Next, onto the surface of the base which had been subjected to the cleaning described above, a first primary layer made of Cu was formed.

The formation of the first primary layer was carried out by wet plating under the following conditions: the temperature of the bath was 60°C , the current density was 3A/dm^2 , and the plating time was 20 minutes.

The average thickness of the thus formed first primary layer was $20\text{ }\mu\text{m}$.

Next, onto the surface of the first primary layer, a second primary layer made of an Cu-Sn based alloy was formed.

The formation of the second primary layer was carried out by wet plating under the following conditions: the temperature of the bath was 60°C, the current density was 3A/dm², and the plating time was 3 minutes.

The average thickness of the thus formed second primary layer was 3 µm.

Next, the base on which the first and second primary layers were laminated was subjected to cleaning. The cleaning was carried out through alkaline immersion decreasing for 30 seconds, and then, after neutralization for ten seconds, the base with the primary layers was washed by water for ten seconds and then it was washed by pure water for ten seconds.

After the cleaning, a coating layer made of a stainless steel was formed on the surface of the third primary layer.

The formation of the coating layer was carried out by ion plating as described below.

First, the base having the first and second primary layers was mounted into an ion plating apparatus. Then, the air inside the ion plating apparatus was discharged so that the internal pressure was reduced to 2×10^{-5} Torr while the inside of the apparatus was being heated.

Thereafter, the air inside the ion plating apparatus was further discharged so that the internal pressure was reduced to 2×10^{-6} Torr, and then a bombardment treatment was carried out for five minutes under the ambient atmosphere of argon gas having a flow rate of 470ml/min.

Subsequently, the internal pressure of the ion plating apparatus was raised to a reduced pressure of 6×10^{-4} Torr, and then the ion plating process was carried out using SUS316L

as a target under the condition of ionization voltage of 40V and ionization current of 40A to form a coating layer made from the stainless steel, thereby obtaining an ornamental part. In this case, the argon gas was used for the ambient atmospheric gas within the ion plating apparatus.

The average thickness of the thus formed coating layer was 2.5 μm .

The thickness of each of the first primary layer, the second primary layer and the coating layer was measured in accordance with the coating thickness measurement by microscope determined by JIS H 5821.

EXAMPLE 9

An ornamental part was produced in the same manner as EXAMPLE 6 mentioned above excepting that a part of the coating layer formed on the surface of the third primary layer of the base was removed by the following steps.

First, a masking coating was formed on a part of the surface of the coating layer so as to have a predetermined pattern or shape.

The formation of the masking coating was made by coating a part of the coating layer with a rubber based resin by means of brush coating, and then drying it at a temperature of 180 to 200°C for 30 minutes. The average thickness of the thus formed masking coating was 500 μm .

Then, a portion of the coating layer on which no masking coating was provided was removed using a peeling agent.

The removal of the coating layer was carried out by immersing it into the peeling agent. As for the peeling agent,

hydrochloric acid was used. The temperature of the peeling agent was 70°C and the immersing time into the peeling agent was 30 minutes, respectively.

Thereafter, by immersing the base into a masking coating removal agent made of a halogen compound based solvent or a ketone based solvent, the masking coating was removed. In this step, the temperature of the masking coating removal agent was 30°C and the immersing time into the masking coating removal agent was 30 minutes.

COMPARATIVE EXAMPLE

A case for a wristwatch as an ornamental part was produced by being subjected to the following surface treatment.

First, a base having a shape of a case for a wristwatch was produced using a Cu-Zn based alloy (alloy composition: 60wt% of Cu and 40wt% of Zn) by means of casting, and then after the necessary portions thereof were cut and ground.

Next, this base was subjected to cleaning. The cleaning of the base was carried out through alkaline electrolytic degreasing for 30 seconds and subsequent alkaline immersion decreasing for 30 seconds, and then, after neutralization for ten seconds, the base was washed by water for ten seconds and then it was washed by pure water for ten seconds.

Onto the surface of the base which had been subjected to the cleaning described above, a coating layer made of Cr was formed.

The formation of the coating layer was carried out by electrolytic plating under the following conditions: the temperature of the bath was 50°C, the current density was 3A/dm², and the plating time was 5 minutes. The average thickness of

the thus formed coating layer was 2.5 μm . The thickness of each of the primary layer and the coating layer was measured in accordance with the coating thickness measurement by microscope determined by JIS H 5821.

The conditions of the surface treatment method for each of Examples and Comparative Example are shown in the following Table 1.

TABLE 1

	Base		Primary Layer		Coating Layer	Masking Coating
	Constituent Material	Manufacturing Method	Constituent Material	Average Thickness (μm)		
Example 1	ABS	Compaction Molding	-	-	SUS444	-
Example 2	Ti	MIM	-	-	SUS444	-
Example 3	Al_2O_3	Powder Metallurgy Sintering	-	-	SUS444	-
Example 4	Cu-Zn Based Alloy	Casting	Ni	5	SUS316L	-
Example 5	Al	Casting	Al_2O_3	20	SUS316L	-
Example 6	Cu-Zn Based Alloy	Casting	First Primary Layer	First Primary Layer	SUS316L	-
			Second Primary Layer	Second Primary Layer		
			Third Primary Layer	Third Primary Layer		
Example 7	PC	Injection Molding	First Primary Layer	First Primary Layer	SUS316L	-
			Second Primary Layer	Second Primary Layer		
			Third Primary Layer	Third Primary Layer		
Example 8	Zn	Casting	First Primary Layer	First Primary Layer	SUS316L	-
			Second Primary Layer	Second Primary Layer		
			Third Primary Layer	Third Primary Layer		
Example 9	Cu-Zn Based Alloy	Casting	First Primary Layer	First Primary Layer	SUS316L	500
			Second Primary Layer	Second Primary Layer		
			Third Primary Layer	Third Primary Layer		
Comp.Ex.	Cu-Zn Based Alloy	Casting	-	-	Cr	-

2. Evaluation of Appearances of Ornamental Parts

Each of the ornamental parts produced by Example 1-9 and Comparative Example was observed by naked eyes and a microscope, and the observed appearances were evaluated in accordance with the following four rankings.

A: Excellent appearance (both of the brightness (whiteness) and the luster were excellent)

B: Good appearance (both of the brightness (whiteness) and the luster were in the normal level)

C: Slightly poor appearance (both of the brightness (whiteness) and the luster were comparatively poor, and irregularities could not be found on the surface)

D: Poor appearance (both of the brightness (whiteness) and the luster were poor, and prominent irregularities could not be found on the surface)

3. Evaluation of Adhesion of Coating Layer

For each of the ornamental parts produced by Example 1-9 and Comparative Example, peeling and blister of the coating layer which would occur when each sample was heated at a temperature of 150°C for 10 minutes and then rapidly cooled down by the water having the room temperature according to JIS H 8166 was evaluated in accordance with the following four rankings.

A: No peeling and blister were observed in the coating layer.

B: Almost no peeling and blister were observed in the coating layer.

C: Slight peeling and blister were observed in the coating layer.

D: Serious peeling and blister were observed in the coating layer.

4. Evaluation of Corrosion Resistance

For each of the ornamental parts produced by Example 1-9 and Comparative Example, corrosion resistance was evaluated by carrying out the following salt solution immersion test.

Each ornamental part which had been once immersed in the salt solution was placed on the gaze or cotton which was soaked with the salt solution within the sealed container such that about half of the height of each ornamental part was immersed in the salt solution. The ornamental part which was in the above state was being left in the atmosphere having the temperature of 40°C and the moisture of 100% for 72 hours, and then the appearance of each ornamental part was observed by naked eyes. In this test, the concentration of the salt solution used was 50g/litter.

The corrosion resistance of each ornamental part was evaluated in accordance with the following four rankings.

- A: No blister of the coating layer and corrosion were observed.
- B: Blister of the coating layer was slightly observed.
- C: Blister of the coating layer was clearly observed.
- D: Corrosion was observed in the surface.

The results of the observations are shown in the following Table 2.

TABLE 2

	Evaluation of Appearance	Evaluation of Adhesion	Evaluation of Corrosion Resistance
Example 1	A	A	B
Example 2	A	A	B
Example 3	A	A	A
Example 4	A	A	A
Example 5	A	A	A
Example 6	A	A	A
Example 7	A	A	A
Example 8	A	A	A
Example 9	A	A	A
Comp.Ex.	C	D	D

As seen from the Table 2, all of the ornamental parts produced using the surface treatment method of the present invention had excellent aesthetic appearance and excellent adhesion with the coating layer. Further, all of the ornamental parts produced using the surface treatment method of the present invention had excellent corrosion resistance. Furthermore, the ornamental parts having the primary layer(s) functioning as a buffer layer had especially excellent corrosion resistance. Moreover, the ornamental part produced from the base which had already been subjected to the mirror finish processing (Example 3) had especially excellent luster and therefore it also had excellent aesthetic appearance as ornamental parts.

In contrast, the ornamental part produced according to the surface treatment method of the comparative example had not only poor aesthetic appearance but also poor adhesion with the coating layer. Further, its corrosion resistance was also poor.

As described above, according to the present invention,

it is possible to easily manufacture ornamental parts having excellent aesthetic appearance in a short time.

Further, it is also possible to obtain ornamental parts having excellent adhesion with the coating layer as well as excellent corrosion resistance and durability.

Furthermore, by appropriately selecting the constituent material of the base, it becomes possible to easily manufacture ornamental parts having complicated shapes and to reduce the weight of the ornamental part and the manufacturing cost thereof.

INDUSTRIAL UTILIZATION

Since the present invention has the above described advantages, it can be applied to, for example, interior decorations such as bibelots; exterior decorations; adornm; external parts of watches such as cases for timepieces, watch straps, watch faces (dials), hands for timepieces, and the like; internal parts of timepieces such as base plates of movements; wheels; bearings; weights, and the like; accessories such as glasses, tiepins, cuff buttons, finger rings, necklaces, bracelets, broaches, pendants, ear rings, pierces, and the like; lighters, and lighter cases; athletic goods such as golf clubs; memorial plates; panels; cups; various mechanical parts such as housings; various containers; and the like.

CLAIMS

1. A surface treatment method for an ornamental part, comprising the steps of:

preparing a base having a surface; and

forming a coating layer composed of a stainless steel on at least a part of the surface of the base by means of a dry plating method.

2. The surface treatment method as claimed in claim 1, wherein the coating layer is formed by means of ion plating.

3. The surface treatment method as claimed in claim 1 or 2, wherein the base is made of an alloy containing at least one of Cu, Zn and Ni.

4. The surface treatment method as claimed in any one of claims 1 to 3, wherein the base is formed by either of casting or metal injection molding.

5. A surface treatment method for an ornamental part, comprising the steps of:

preparing a base having a surface;

forming at least one primary layer on at least a part of the surface of the base; and

forming a coating layer composed of a stainless steel on at least a part of the primary layer by means of a dry plating method.

6. The surface treatment method as claimed in claim 5, wherein the coating layer is formed by means of ion plating.

7. A surface treatment method for an ornamental part, comprising the steps of:

preparing a base having a surface, said base being made of a metal material;

forming at least one primary layer on at least a part of the surface of the base; and

forming a coating layer composed of a stainless steel on at least a part of the primary layer by means of ion plating.

8. The surface treatment method as claimed in any one of claims 5 or 7, wherein the base is made of an alloy containing at least one of Cu, Zn and Ni.

9. The surface treatment method as claimed in any one of claims 5 to 8, wherein the base is formed by either of casting or metal injection molding.

10. The surface treatment method as claimed in any one of claims 5 to 9, wherein at least one of the primary layers functions as a buffer layer which buffers the potential difference between one surface of the layer and the other surface thereof.

11. A surface treatment method for an ornamental part, comprising the steps of:

preparing a base having a surface, said base being made of a non-metallic material;

forming at least one primary layer on at least a part of the surface of the base; and

forming a coating layer composed of a stainless steel on at least a part of the surface of the primary layer by means of ion plating.

12. The surface treatment method as claimed in any one of claims 5 to 11, wherein the primary layer is composed of at least one of Cu, Co, Pd, Au, Ag, In, Sn, Ni, Ti, Zn, Cr, Al and Fe, or an alloy containing at least one of the metals.

13. The surface treatment method as claimed in any one of claims 5 to 11, wherein the primary layer is composed of a

metallic compound.

14. The surface treatment method as claimed in any one of claims 5 to 13, wherein the at least one primary layer includes two or more primary layers.

15. The surface treatment method as claimed in claim 14, wherein the adjacent two primary layers are formed of materials containing the same element.

16. The surface treatment method as claimed in claim 15, wherein the same element is Cu.

17. A surface treatment method for an ornamental part, comprising the steps of:

preparing a base having a surface, said base being made of a non-metallic material; and

forming a coating layer composed of a stainless steel on at least a part of the surface of the base by means of ion plating.

18. The surface treatment method as claimed in any one of claims 1 to 17, wherein the average thickness of the coating layer is 0.1 to 5.0 μm .

19. The surface treatment method as claimed in any one of claims 1 to 18, wherein at least a part of the surface of the base is subjected to a surface treatment selected from a mirror finish processing, a hair line processing or a satin finish processing.

20. The surface treatment method as claimed in any one of claims 1 to 19, further comprising, prior to the step of forming the coating layer, the step of performing a cleaning treatment against at least a part of the surface of the base.

21. The surface treatment method as claimed in claim 20,

wherein the cleaning treatment is a bombardment treatment.

22. The surface treatment method as claimed in any one of claims 1 to 21, further comprising, prior to the step of forming the coating layer, the steps of forming a masking coating on at least a part of the surface of the coating layer, removing the coating layer on which the masking coating is not provided by using a peeling agent, and removing the masking coating.

23. The surface treatment method as claimed in claim 22, wherein the average thickness of the masking coating is 100 to 2000 μm .

24. An ornamental part which is produced by the surface treatment method defined in any one of claims 1 to 23.