A alloy surface treatment includes dewaxing and deoiling to an alloy surface via a cleaning process; sealing holes on the alloy surface with an organic material; forming a first coating on the alloy surface with a UV curing material; providing a plasma treatment to activate the alloy surface, then providing a PVD process to form a second coating outside the alloy; forming a third coating on the alloy surface with another UV curing material which further includes a toner therein, then forming a fourth coating on the alloy surface with the UV curing material, wherein the toner is provided to match the color of hexavalent-chromium to obtain a hexavalent-chromium imitated product.
METHOD OF ALLOY SURFACE TREATMENT

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

This invention is related to an alloy surface treatment, especially for forming an hexavalent-chromium imitated appearance on the alloy surface in order to enhance the ability of anti-corrosion.

[0002] 2. Description of the Related Art

An zinc alloy is composed of a major component, zinc, with other secondary components, such as aluminum, copper, magnesium, chromium, lead, titanium and etc., which makes the alloy have lower melting point and good malleability to be easily manufactured. For the alloy, there is a situation where the alloy has quite amounts of impurities such as lead, chromium and tin, which causes the alloy to be more rapidly decaying, easily transformed and even easily breaking. For a reason that the elements, such as lead, tin and chromium, have weak solubility in metal, the elements are possibly converged together to form a cathode or a anode within the alloy crystalline grain, where the cathode and the anode is able to easily cause electrochemical corrosion under an unknown humidity environment. Because the metal has the extremely bad chemical stability, wherever in the air, the acidic environment or the alkaline environment, and the most conventional solution is to form a electroplating to cover the metal surface to prevent any external corrosion. However, in a process like metal casting, the metal has a good quality of dense surface, that is, no holes on the surface, but the structure under the surface is not dense enough, and once the surface is damaged to expose the sub-layer, it is hardly electroplating onto the metal surface. To achieve the steady combination of the plating and the metal surface, a compound of copper and cyanide is used to form a pre-layer before plating, even so this kind of compound is almost prohibited in the present manufacture due to the harmful influence to the nature and the health.

[0005] To achieve a preferred characteristic of the anticorrosion surface of the alloy, there are many solutions are illustrated below.

[0006] A metal product and a produce method thereof are disclosed in an application, No. CN101200128, a zinc alloy product comprises a zinc alloy substrate and a vacuum coating layer on the zinc alloy substrate surface, wherein the product also comprises an UV-curable coating disposed between the zinc alloy substrate and the vacuum coating layer. The method for producing the zinc alloy product, an UV-curable coating is provided between the zinc alloy substrate and the vacuum coating layer of the zinc alloy substrate provided in the invention, so that the surface roughness of the zinc alloy substrate is able to be effectively reduced. Moreover, the adhesive force of this coating with the vacuum coating layer is also excellent. Therefore, the obtained zinc alloy product has a surface with high glossiness.

[0007] A preparation method of filling closure of holes on surface of zinc die casting alloy is disclosed in an application, No. CN101944138, the preparation method comprises the following steps of: performing low melting point metal plating on the surface of the zinc alloy after dewaxing, degreasing and deoiling; rinsing and drying the surface of the zinc alloy after reaching the target thickness; performing the processes of anoxbiotic heating surface smelting and quenching to exhaust the gas in the distant holes after the zinc alloy is heated; performing penetration to fill up the distant holes of the zinc alloy by using the surface tension of a surface low melting point metal coating in a melting state; and reducing the crystal form size of the alloy, strengthening the structural strength, increasing the air tightness of the surface of a work-piece and preventing regeneration of the distant holes by using a quenching process. The filling closure and the preparation method are favorable for any surface treatment post-process of zinc alloy material blanks.

[0008] A coating process for aluminum alloy is disclosed in an application, No. CN101343740, the process comprises procedures of oil removing, cleaning and drying, pre-treating, epoxy polyester powder spraying and solidifying, first grinding, methyl methacrylate-acrylate copolymer paint spraying and solidifying, second grinding, polybutadiene high temperature resistant insulating coating spraying and solidifying, vacuum cathode arc ion chromium plating and magnetism control sputtering aluminum plating, and polyurethane methacrylate light solidifying paint spraying as well as solidifying in sequence.

[0009] A hexavalent-chromium appearance imitated plating method is disclosed in an application, No. CN10228471, the method comprises cleaning by using a dry method; carrying out ultraviolet curing on a prime coat; carrying out evaporation coating; carrying out another evaporation coating; and carrying out another ultraviolet curing. The formed membrane is isolated from the outside by using a silica membrane so as to form a totally-closed structure, then through carrying out color-matching by using a finishing paint.

SUMMARY OF THE INVENTION

[0010] To reach the purpose of zinc or aluminum alloy surface treatment without nature pollution and health harm, a method is provided to an alloy surface treatment which obtains an imitated hexavalent-chromium appearance and further enhances the corrosion ability of the alloy surface. The method to the environment is more eco-friendly because the poison materials, such as cyanide, used in the conventional ways are able to be replaced.

[0011] The surface treatment includes: dewaxing and deoiling to an alloy surface by using of a hydrogen-carbon vacuum cleaning (no water waste); sealing holes on the alloy surface with an organic material; forming a first coating on the alloy surface with an UV curing material; providing a plasma treatment to activate the alloy surface, then providing a physical vapor deposition process to form a second coating outside the alloy; forming a third coating on the alloy surface with another UV curing material which further comprises a toner therein, then forming a fourth coating on the alloy surface with the UV curing material. In the convention way, the healthy, harmful cyanide is commonly used for plating, however it is no need in the invention because the coating and cleaning process of the invention is carrying out in a dry way, accordingly the water waste is able to be avoided.

DETAILED DESCRIPTION OF THE INVENTION

First Preferred Embodiment of the Invention

[0012] A surface treatment comprises five steps, which are illustrated below.

[0013] Step 1, dewaxing and deoiling to a polished zinc alloy blank with hydrogen-carbon (HC) vacuum cleaning for 5 minutes.
[0014] Step 2, sealing the holes of cleaned zinc alloy blank surface at room-temperature (RT) while soaking the zinc alloy blank in a silanes fluid for 5 seconds, then drying the zinc alloy blank at a temperature 130°C for 5 minutes, so as to form a silanes protecting layer outside the zinc alloy surface. Here, the silanes fluid is composed of the KI-560 (CH₂OCH₂CH₂O(CH₂)₃Si(OCH₂)₃), the deionized water and the ethanol, which is in the ratio of 4:5:91.

[0015] Step 3, Providing a first spray coating to the silanes-layered zinc alloy with an ultraviolet (UV) curing paint to form a first coating, thickness 30 μm, then sending the first-coated zinc alloy into the heating environment of temperature 70°C for 3 minutes in order to dry and level the first coating, thereafter providing a first UV radiation for 10 seconds to solidify the first coating, where the first UV radiation energy is 1500 mJ/cm². Here, the said UV curing paint is able to be solidified while the paint interacts with an ultraviolet.

[0016] Step 4, providing a plasma treatment to activate the zinc alloy surface and forming a second coating (such as metal-oxide coating or nitrogenous coating) via a physical vapor deposition (PVD) process, where the plasma treatment is operated according to the control parameters of that the ion source current (DC or medium frequency pulse form) is 0.5 A; the biasing is 800 V; the Mark-Space ratio is 50%; the argon gas flow velocity is 100 SCCM; the oxygen flow velocity is 10 SCCM; the pressure of the plasma environment is 0.3 Pa and the plasma activation time is 10 minutes. The PVD is operated according to the control parameters of that the operating current is 50 A; the operating voltage is 4000 V; the deposing time is 2 minutes; the biasing is 60 V; the Mark-Space ratio is 50%; the argon gas flow velocity is 60 SCCM; and the nitrogen gas flow velocity is 100 SCCM. Here, the target (coating material) using for the PVD process is aluminum.

[0017] Step 5, providing second spray coating with another UV curing paint which is mixed with a hexavalent-chromium imitated toner therein to form a third coating thickness 5 μm outside the PVD-coated zinc alloy, then sending the third-coated zinc alloy into the environment of temperature 50°C for 10 minutes to dry and level the third coating, thereafter providing a second UV radiation for 10 seconds to solidify the third coating, where the second UV radiation energy is 500 mJ/cm², then providing third spray coating with the UV curing paint (no toner) to form a fourth coating, thickness 25 μm outside the third coated zinc alloy, the next is sending the fourth-coated zinc alloy into an infrared (IR) radiation of the temperature 70°C for 3 minutes to dry and level the fourth coating, and finally providing a third UV radiation for 45 seconds to solidify the fourth coating, where the third UV radiation energy is 500 mJ/cm².

[0018] In the first preferred embodiment, the UV curing paint is related to a polyurethane acrylate.

[0019] In a color space measurement, the product color made from the surface treatment of the first preferred invention of the invention is measured a corresponding first \( I^* \) \( A^* \) \( B^* \) value, \( I^* \approx 85.89 \), \( A^* \approx 0.92 \) and \( B^* \approx -0.35 \), which is similar to the \( I^* \) \( A^* \) \( B^* \) value (\( I^* \approx 85.23 \), \( A^* \approx -1.23 \) and \( B^* \approx 0.65 \)) of a plated hexavalent-chromium, such that the hexavelent-chromium imitated appearance is able to be achieved by the surface treatment of the first preferred embodiment of the invention.

Second Preferred Embodiment of the Invention

[0020] A surface treatment comprises five steps, which are illustrated below.

[0021] Step 1, dewaxing and deoiling to a polished aluminum alloy blank with dry-ice cleaning and factitious cleaning.

[0022] Step 2, sealing the holes of cleaned aluminum alloy blank surface at RT while soaking the aluminum alloy blank in a silanes fluid for 120 seconds, then drying the aluminum alloy blank for 30 minutes at temperature 100°C, so as to form a silanes protecting layer outside the aluminum alloy surface, the silanes fluid is composed of the KI-560, the deionized water and the ethanol, which is in the ratio of 4:5:93.

[0023] Step 3, providing first spray coating to a first coating, thickness 15 μm outside the silanes-layered aluminum alloy with an UV curing paint, then sending the first-coated aluminum alloy into the environment of temperature 50°C for 10 minutes to dry and level the first coating, thereafter providing a first UV radiation for 10 seconds to solidify the first coating, where the first UV radiation energy is 500 mJ/cm².

[0024] Step 4, providing a plasma treatment to activate the aluminum alloy surface and forming a second coating by a PVD process, where the plasma treatment is operated according to the control parameters of that the ion source current is 0.3 A; the biasing is 1500 V; the Mark-Space ratio is 80%; the argon gas flow velocity is 100 SCCM; the oxygen flow velocity is 100 SCCM; the plasma environment is 0.3 Pa and the plasma activation time is 5 minutes. The PVD is operated according to the control parameters of that the operating current is 500 A; the operating voltage is 800 V; the deposing time is 0.3 minutes; the biasing is 20 V; the Mark-Space ratio is 80%; and the argon gas flow velocity is 200 SCCM. Here, the target using for the PVD process is silver.

[0025] Step 5, providing a second spray coating with another UV curing paint which is mixed with a hexavalent-chromium imitated toner therein to form a third coating, thickness 10 μm outside the PVD-coated aluminum alloy, then sending the third-coated aluminum alloy into the environment of temperature 70°C for 3 minutes to dry and level the third coating, thereafter performing a second UV radiation for 45 seconds to solidify the third coating, where the second UV radiation energy is 1500 mJ/cm², then providing third spray coating with the UV curing paint (no toner) to form a fourth coating, thickness 15 μm outside the third-coated aluminum alloy, the next is sending the fourth-coated aluminum alloy into an IR radiation of the temperature 50°C for 10 minutes to dry and level the fourth coating, and finally providing a third UV radiation for 10 seconds to solidify the fourth coating, where the third UV radiation energy is 1500 mJ/cm².

[0026] Here in the second preferred embodiment, the UV curing paint is related to a polyurethane acrylate.

[0027] In the color space measurement, the product color made from the surface treatment of the second preferred invention of the invention is measured a second \( I^* \) \( A^* \) \( B^* \) value, \( I^* \approx 85.56 \), \( A^* \approx -0.78 \) and \( B^* \approx -0.45 \), which is also similar to the \( I^* \) \( A^* \) \( B^* \) value of a plated hexavalent-chromium, such that the appearance of the second product is imitative to the real color of the hexavalent-chromium.

Third Preferred Embodiment of the Invention

[0028] A surface treatment comprises five steps, which are illustrated below.

[0029] Step 1, dewaxing and deoiling to a polished aluminum alloy blank with HC vacuum cleaning for 10 minutes.
Step 2, sealing the holes of cleaned aluminum alloy blank surface at RT while soaking the aluminum alloy blank in a silanes fluid for 30 seconds, then drying the aluminum alloy blank at a temperature 110°C for 15 minutes, so as to form a silanes protecting layer outside the metal surface, the silanes fluid is composed of the KH-560, the deionized water and the ethanol, which is in the ratio of 3:5:92.

Step 3, providing a first spray coating to the silanes layered aluminum alloy with an UV curing paint for a first coating, thickness 20 μm, then sending the first-coated aluminum alloy into the environment of temperature 60°C for 7 minutes to dry and level the first coating, thereafter providing a first UV radiation for 30 seconds to solidify the first coating, where the first UV radiation energy is 800 mJ/cm².

Step 4, providing a plasma treatment to activate the aluminum alloy surface and forming a second coating by a PVD process, where the plasma treatment is operated according to the control parameters of that the ion source current is 0.4 A; the biasing is 100V; the Mark-Space ratio is 60%; the argon gas flow velocity is 50 SCCM; the oxygen flow velocity is 10 SCCM; the plasma environment is 0.3 Pa and the plasma activation time is 6 minutes. The PVD is operated according to the control parameters of that the operating current is 100 A; the operating voltage is 500V; the depositing time is 1 minutes; the biasing is 40V; the Mark-Space ratio is 60%; the argon gas flow velocity is 100 SCCM; and the oxygen gas flow velocity is 100 SCCM. Here, the target using for the PVD process is antimony.

Step 5, providing a second spray coating with another UV curing paint which is mixed with a hexavalent-chromium imitated toner therein to form a third coating, thickness 8 μm outside the PVD-coated aluminum alloy, then sending the third-coated aluminum alloy into the environment of temperature 60°C for 5 minutes to dry and level the third coating, thereafter providing a second UV radiation for 30 seconds to solidify the third coating, where the second UV radiation energy is 800 mJ/cm², then providing a third spray coating with the UV curing paint (no toner) to form a fourth coating, thickness 10 μm outside the third-coated aluminum alloy, the next is sending the fourth-coated aluminum alloy into an IR radiation of the temperature 60°C, for 15 minutes to dry and level the third UV coating, and finally providing a third UV radiation for 30 seconds to solidify the third UV coating, where the third UV radiation energy is 800 mJ/cm².

Here in the third preferred embodiment, the UV curing paint is related to a polyurethane acrylate.

In the color space measurement, the product color made from the surface treatment of the third preferred embodiment of the invention is measured a third L\*a\*b\* value, L\* = 85.13, a\* = -0.99 and b\* = -0.86, which is also similar to the L\*a\*b\* value of the plated hexavalent-chromium, such that the appearance of the third product is imitative to the real color of the hexavalent-chromium.

In the aforementioned preferred embodiments of the invention, the target using for the PVD process further includes indium and chromium.

Many changes and modifications in the above described embodiment of the invention are able to, of course, be carried out without departing from the scope thereof. Accordingly, to promote the progress in science and the useful arts, the invention is disclosed and is intended to be limited only by the scope of the appended claims.

What is claimed is:
1. An surface treatment comprising: dewatering and deoiling to an alloy surface by using of a cleaning process; sealing holes on the alloy surface with an organic material; forming a first coating outside the alloy surface with a first passive curing material; providing a plasma treatment to activate the alloy surface; then providing a PVD process to form a second coating outside the alloy surface; forming a third coating outside the alloy surface with a second passive curing material which further comprises a toner therein, then forming a fourth coating outside the alloy surface with a third passive curing material.
2. The surface treatment of claim 1, wherein the cleaning process is selected from a group consisted of hydrogen-carbon vacuum cleaning, dry ice cleaning and factious cleaning.
3. The surface treatment of claim 2, wherein the organic material is related to a silanes fluid.
4. The surface treatment of claim 3, wherein the first, second and the third passive material are related to an UV curing paint.
5. The surface treatment of claim 4, wherein the plasma treatment is operated according to the control parameters of that the ion source current is 0.3–0.5 A; the biasing is 80–150V; the Mark-Space ratio is 50–80%; the argon gas flow velocity is 10–100 SCCM; the oxygen flow velocity is 10–150 SCCM; the pressure of the plasma environment is 0.3 Pa; and the activation time is 5–10 minutes.
6. The surface treatment of claim 5, wherein the PVD is operated according to the control parameters of that the operating current is 50–300 A; the operating voltage is 400–800V; the depositing time is 5–10 minutes; the biasing is 20–60V; the Mark-Space ratio is 50–80%; the argon gas flow velocity is 60–200 SCCM; the oxygen flow velocity is 0–100 SCCM; and the nitrogen gas flow velocity is 0–100 SCCM, furthermore the coating material for the PVD process is selected from a group consisted of aluminum, chromium, indium, tin, antimony and silver.
7. The surface treatment of claim 6, wherein the UV curing paint is provided to match the color of hexavalent-chromium.
8. The surface treatment of claim 7, wherein the sealing holes process is to soak the alloy in the silanes fluid for 5–120 seconds and dry the alloy at the temperature 100–150°C, where the silanes fluid is proportionally consisted of KH-560, deionized water and ethanol, which is in the ratio of (2–4):5: (91–93).
9. The surface treatment of claim 8, wherein the first, the third and the fourth coatings are able to be solidified and leveled respectively via an UV radiation reaction for 10–45 seconds and a baking process at temperature 50–70°C for 3–10 minutes, where the UV radiation energy is 500–1500 mJ/cm².
10. The surface treatment of claim 9, wherein the UV curing paint is a polyurethane acrylate.

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