US 20080149492A1

(19) United States

(12) Patent Application Publication

LIN et al.

(10) Pub. No.: US 2008/0149492 A1

(43) Pub. Date: Jun. 26, 2008

(54) **SURFACE DYEING PROCESS FOR METAL ARTICLES**

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(21) Appl. No.: **11/769,652**

(22) Filed: **Jun. 27, 2007**

(30) **Foreign Application Priority Data**

Dec. 20, 2006 (CN) 200610157706.4

Publication Classification

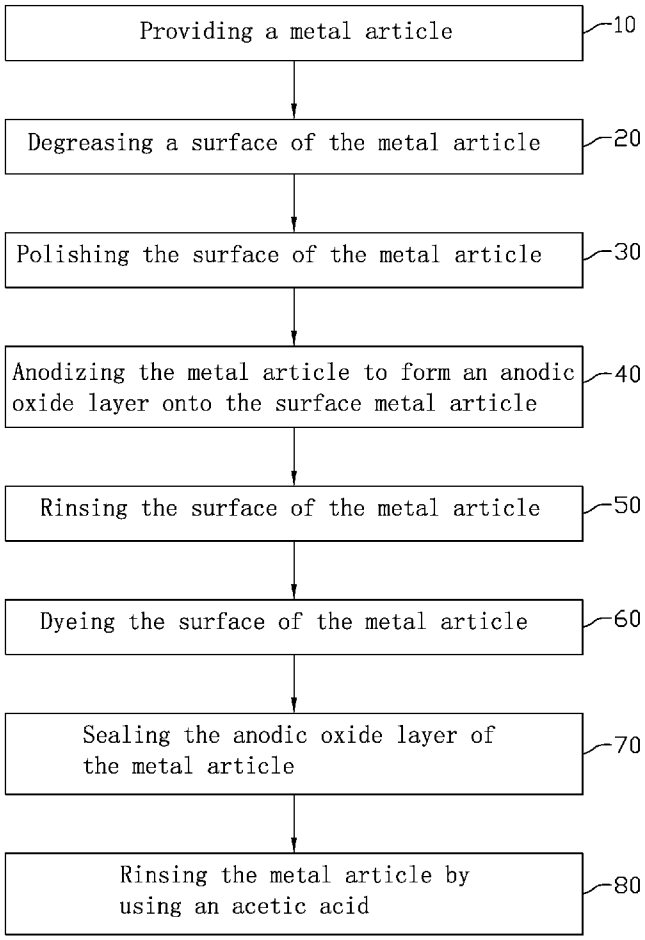
(51) **Int. Cl.**

C25D 11/02	(2006.01)
C25D 11/16	(2006.01)
C25D 11/18	(2006.01)
C25D 11/30	(2006.01)
C25D 11/34	(2006.01)

(52) **U.S. Cl.** **205/206**; 205/229; 205/324

(57) **ABSTRACT**

A surface treatment process for a metal article includes the following steps. Firstly, a metal article is provided. Secondly, the metal article is anodized to form an anodic oxide layer on a surface thereof. Thirdly, the surface of the metal article is rinsed. Fourthly, the surface of the metal article is dyed. Fifthly, the now-dyed anodic oxide layer of the metal article is sealed. Finally, the metal article is rinsed using an acetic acid solution.



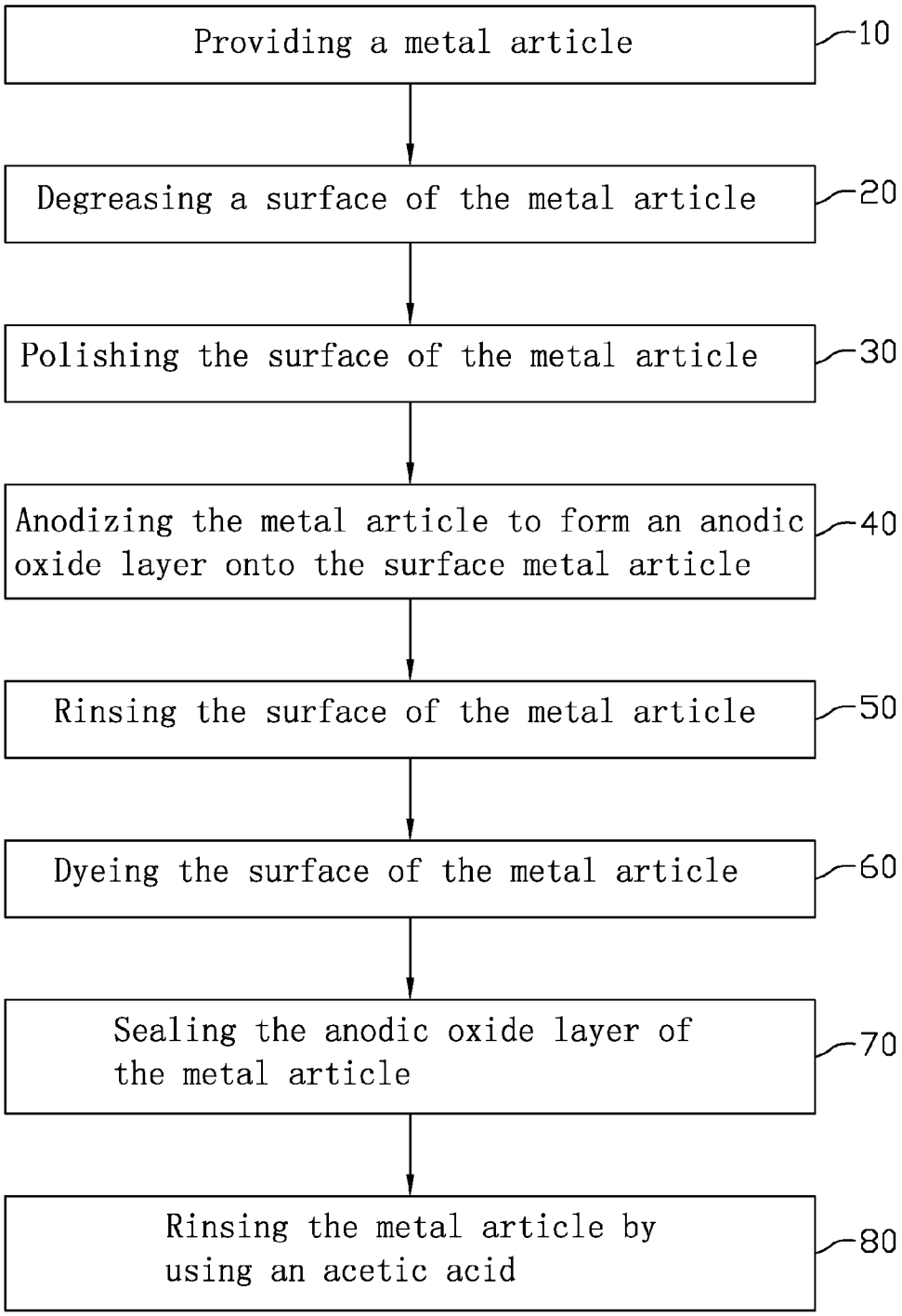

Providing a metal article
10
Degreasing a surface of the metal article
20
Polishing the surface of the metal article
30
Anodizing the metal article to form an anodic oxide layer onto the surface metal article
40
Rinsing the surface of the metal article
50
Dyeing the surface of the metal article
60
Sealing the anodic oxide layer of the metal article
70
Rinsing the metal article by using an acetic acid
80

FIG. 1

SURFACE DYEING PROCESS FOR METAL ARTICLES

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to surface treatment processes and, particularly, to an anodizing and dyeing process for a metal article.

[0003] 2. Description of Related Art

[0004] Metal articles made of, e.g., aluminum, magnesium, titanium, or alloys thereof, with a high-quality mechanical performance have tremendous applications in many industries. The articles usually need to be processed via surface treatment process for improving corrosion resistance or abrasion resistance thereof. Anodizing is an effective surface treatment carried out on metal articles for the purpose of improving the decorative quality and/or surface durability of the metal articles.

[0005] During anodizing of such metal articles, a porous anodic oxide film is formed over the surface of the metal articles. The anodized metal articles are often subsequently colored to obtain desired decorative appearances. The coloring of the metal articles can be further carried out (i.e., accomplished) by submersion in a dye solution or otherwise applying a dye thereto. An organic dye dissolved in the dye solution is introduced into pore openings of the porous anodic oxide film of the metal articles. The organic dye can be absorbed through a surface region of the porous anodic oxide film on the metal articles. A sealant is then applied onto the porous anodic oxide film, so as to reduce the dimensions of the pores of the porous anodic oxide film and to thereby reduce, if not prevent, the opportunity for fading of the organic dye absorbed through the porous anodic oxide film.

[0006] However, during coloring of the metal articles, super-absorption of the organic dye to the porous anodic oxide film may result in formation of a gray film and thus cause cloudiness in the surface region of the porous anodic oxide film.

[0007] Therefore, a surface treatment process for a metal article is desired in order to overcome the above-described shortcomings.

SUMMARY OF THE INVENTION

[0008] In one embodiment thereof, a surface treatment process for a metal article is provided. In a first step of the surface treatment process, a metal article is provided. In a second step of the surface treatment process, the metal article is anodized to form an anodic oxide layer on a surface thereof. In a third step of the surface treatment process, the surface of the metal article is rinsed. In a fourth step of the surface treatment process, the surface of the metal article is dyed. In a fifth step of the surface treatment process, the anodic oxide layer of the metal article is sealed. In a sixth step of the surface treatment process, the metal article is rinsed using an acetic acid.

[0009] Other advantages and novel features will become more apparent from the following detailed description of preferred embodiments when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Many aspects of the present surface treatment process for a metal article can be better understood with reference to the following drawing. The components in the drawing are not necessarily drawn to scale, the emphasis instead being placed upon clearly illustrating the principles of the present surface treatment process for a metal article. Moreover, in the drawing, like reference numerals designate corresponding parts throughout the several views.

[0011] FIG. **1** is a flow chart of a surface treatment process for a metal article, in accordance with a present embodiment.

DETAILED DESCRIPTION OF THE INVENTION

[0012] Referring to FIG. **1**, in a present embodiment, a surface treatment process for a metal article includes steps **10** to **80**.

[0013] In step **10**, a metal article made of, e.g., aluminum, magnesium, titanium, or alloys thereof is provided.

[0014] In step **20**, a process for degreasing a surface of the metal article is carried out using, advantageously, an alkali-based cleaning solution so as to remove oil stains on the metal article. After being degreased, the metal article is subsequently rinsed in flowing water. It is to be understood that, additionally or alternatively, other degreasing agents, such as surfactants, could be employed in step **20**.

[0015] In step **30**, the metal article is, usefully, chemically polished in a chemical polishing solution. The metal article is dipped into the chemical polishing solution, which beneficially contains about 80 wt. % (percent by weight) to 90 wt. % phosphoric acid, 3 wt. % to 5 wt. % sulfuric acid, and 6 wt. % to 7 wt. % nitric acid. It is to be further understood that a chemical-mechanical polishing (CMP) step, as well, is considered to be within the scope of the present polishing step. During the chemical polishing step, a superfluous metal oxide film may be formed on the metal article, and thus a process for removing the superfluous metal oxide film may be required. The process for removing the superfluous metal oxide film can be performed, e.g., by dipping the metal article into a chromic acid solution.

[0016] In step **40**, an anodizing process is then performed upon the surface of the metal article. As such, an anodic oxide layer with a plurality of fine pores therein is formed on the surface of the metal article. The process for anodizing the metal articles particularly involves a cleaning sub-step and an electrolysis sub-step. The cleaning sub-step is advantageously carried out in an alkaline solution, such as sodium hydroxide or sodium carbonate. The electrolysis sub-step is usefully carried out in a phosphoric acid electrolyte containing 0.2~1.0 wt. % phosphoric acid, while using the metal article as an anode. A direct current in an approximate range from 20 volts to 60 volts should be applied to the metal article. The metal article is then anodized in the electrolyte at a current density of 10~50 milliamperes per square centimeter and at a temperature in an approximate range from 20° C. to 26° C. for about 20 minutes. As the electrolysis proceeds, the anodic oxide layer grows on the surface of the metal surface, with the thickness of the oxide layer increasing as the electrolysis continues (i.e., the thickness can, in part, be controlled by varying the time, as desired). The electrolysis step also can instead be carried out in a sulfuric acid with a concentration in an approximate range from 100-200 g/l. The direct current applied to the metal article is 8-16 volts and has a current density of 10~20 milliamperes per square centimeter.

[0017] In step **50**, the metal article is rinsed by flowing water, so as to remove the electrolyte solution.

[0018] In step **60**, the metal article is immersed into a dye solution, so as to color the surface of the metal article. The dye

solution contains an organic dye in a concentration in an approximate range from 1 g/l to 10 g/l. During the coloring of the metal article, dye particles in the dye solution penetrate into the pores of the anodic oxide layer of the metal article, thus coloring the surface of the metal article.

[0019] In step **70**, the metal article is rinsed and subsequently processed in a sealing process. The sealing process is carried out in a nickel salt solution, e.g. nickel acetate and/or nickel fluoride. The metal article is immersed in the nickel salt solution for 10 minutes to 60 minutes, with the nickel salt solution being maintained about at a temperature of 90° C. to 96° C. Such a sealing process results in a nickel plating (i.e., sealant layer) on the anodic oxide layer. It is to be understood that another type of metallic salt could be employed in order to achieve another sealant composition.

[0020] In step **80**, the metal article is rinsed in an acetic acid solution. The sealed metal article is immersed in the acetic acid solution at an acetic acid concentration, usefully, in an approximate range from 0.3 wt % to 0.6 wt %, so as to remove foreign materials (e.g., superfluous dye particles absorbed in the anodic oxide layer of the metal article and/or inorganic impurities introduced during the sealing process). During the rinsing of the metal article, the acetic acid solution is maintained, advantageously, at an approximate temperature of 50° C. to 70° C.

[0021] The metal article rinsed in the acetic acid solution is further rinsed in flowing water, and thus a colored metal article with good wear/durability characteristics and bright luster is obtained.

[0022] It should be understood, however, that even though numerous characteristics and advantages of the present embodiments have been set forth in the foregoing description, together with details of the structures and functions of the embodiments, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size, and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed is:

1. A surface treatment process for a metal article, comprising the steps:

providing a metal article;

anodizing the metal article to form an anodic oxide layer on a surface of the metal article;

rinsing the surface of the metal article;

dyeing the surface of the metal article;

sealing the dyed anodic oxide layer of the metal article; and

after the step of sealing, rinsing the metal article by using an acetic acid solution.

2. The surface treatment process as claimed in claim **1**, wherein the metal article is comprised of at least one of aluminum, magnesium, and titanium.

3. The surface treatment process as claimed in claim **1**, further comprising a pretreatment process before the step of anodizing the metal article, the pretreatment process including a step of degreasing the surface of the metal article and a step of polishing the surface of the metal article.

4. The surface treatment process as claimed in claim **3**, wherein the step of degreasing the surface of the metal article is carried out in an alkali-based cleaning solution.

5. The surface treatment process as claimed in claim **3**, wherein the step of polishing the surface of the metal article is carried out in a chemical polishing solution, which contains 80 wt. % to 90 wt. % phosphoric acid, 3 wt. % to 5 wt. % sulfuric acid, and 6 wt. % to 7 wt. % nitric acid.

6. The surface treatment process as claimed in claim **3**, further comprising a step of dipping the metal article in a chromic acid solution after the step of polishing.

7. The surface treatment process as claimed in claim **1**, wherein the anodizing of the metal article involves a cleaning step and an electrolysis step, the cleaning step being carried out in an alkaline solution, the electrolysis step being carried out in an electrolyte containing 0.2~1.0 wt. % phosphoric acid and using the metal article as an anode.

8. The surface treatment process as claimed in claim **7**, wherein during the electrolysis step, the metal article is anodized in the electrolyte at a current density of 10~50 milliamperes per square centimeter, with a direct current in a range from 20 volts to 60 volts applied thereto.

9. The surface treatment process as claimed in claim **1**, wherein the anodizing of the metal article involves a cleaning step and an electrolysis step, the cleaning step being carried out in an alkaline solution, the electrolysis step being carried out in an electrolyte containing sulfuric acid at a concentration in an approximate range from 100 g/l to 200 g/l.

10. The surface treatment process as claimed in claim **9**, wherein during the electrolysis step, the metal article is anodized in the electrolyte at a current density of 10~20 milliamperes per square centimeter and at a temperature in an approximate range from 20° C. to 26° C.

11. The surface treatment process as claimed in claim **1**, wherein the dyeing of the surface of the metal article is carried out in a dye solution containing an organic dye at a concentration in an approximate range from of 1 g/l to 10 g/l.

12. The surface treatment process as claimed in claim **1**, wherein the sealing step is carried out in a nickel salt solution comprising at least one of nickel acetate and nickel fluoride.

13. The surface treatment process as claimed in claim **1**, wherein the acetic acid solution has a concentration in an approximate range from 0.3 wt % to 0.6 wt %.

14. The surface treatment process as claimed in claim **1**, wherein during the rinsing of the metal article, the acetic acid solution is maintained at a temperature in an approximate range from 50° C. to 70° C.

15. A process of treating an anodic oxide layer of an anodized metal article, comprising the steps:

dyeing the anodic oxide layer of the anodized metal article;

sealing the anodic oxide layer of the anodized metal article to yield a sealed, anodized metal article; and

rinsing the sealed, anodized metal article using an acetic acid solution.

16. The surface treatment process as claimed in claim **15**, wherein the acetic acid solution has a concentration in an approximate range from 0.3 wt % to 0.6 wt %.

17. The surface treatment process as claimed in claim **15**, wherein the acetic acid solution is maintained at a temperature in an approximate range from 50° C. to 70° C.

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