



Europäisches
Patentamt
European
Patent Office
Office européen
des brevets



(11)

EP 2 942 423 A1

(12)

EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:

11.11.2015 Bulletin 2015/46

(51) Int Cl.:

C25D 11/04 (2006.01)

C25D 11/16 (2006.01)

C25D 11/18 (2006.01)

(21) Application number: 14861982.8

(86) International application number:

PCT/KR2014/005119

(22) Date of filing: 11.06.2014

(87) International publication number:

WO 2015/072640 (21.05.2015 Gazette 2015/20)

(84) Designated Contracting States:

AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR

Designated Extension States:

BA ME

(30) Priority: 18.11.2013 KR 20130139920

(72) Inventor: CHAE, Soo Yoen

Hwaseong-si
Gyeonggi-do 445-821 (KR)

(74) Representative: Beck & Rössig
European Patent Attorneys

Cuvilliésstraße 14
81679 München (DE)

(71) Applicant: Kwang Dong Hitech Co., Ltd

Kwangju-si 506-253 (KR)

(54) METHOD FOR TREATING SURFACE OF ALUMINUM ALLOY

(57) Disclosed is a method of surface-treating an aluminum alloy, including pretreating an aluminum alloy; immersing the pretreated aluminum alloy in an etching solution having a predetermined composition so that the surface of the aluminum alloy is etched, thus forming a

transparent glossy film; subjecting the aluminum alloy having the transparent glossy film to anodic oxidation, thus forming an oxide film on the surface of the aluminum alloy; and post-treating the aluminum alloy having the oxide film.

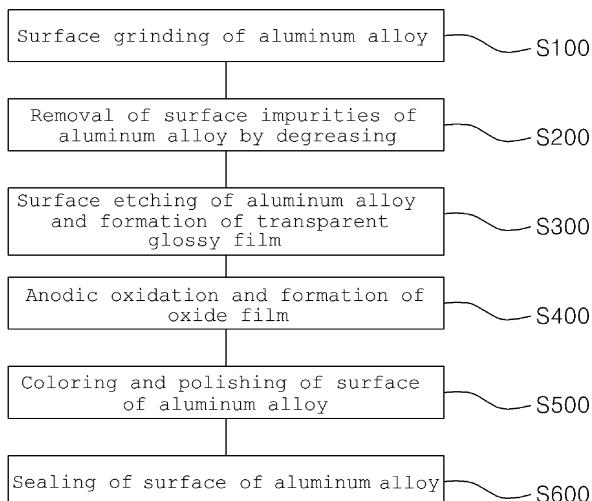


FIG. 1

Description**Technical Field**

[0001] The present invention relates to a method of surface-treating an aluminum alloy, and more particularly, to a method of surface-treating an aluminum alloy, wherein a target material comprising an aluminum alloy is immersed in a mixed aqueous solution of acidic ammonium fluoride and boric acid to remove grinding pad marks and scratches generated upon mechanical grinding thereof, and is then subjected to anodic oxidation, thereby obtaining a high-gloss surface of the aluminum alloy.

Background Art

[0002] Typically, the surface of an aluminum alloy subjected to a rolling or extrusion process includes rough marks, and thus such a rough surface of the aluminum alloy is removed by mechanical grinding and etching.

[0003] An anodic oxidation method, which is a metal surface treatment method, is referred to as an alumite process. Specifically, when aluminum or an aluminum alloy is immersed in a solution of sulfuric acid, oxalic acid or chromic acid so as to undergo anodic electrolysis, anodic oxidation occurs, thus forming an anodic oxide film ($Al_2O_3 \cdot xH_2O$) on the surface of aluminum, ultimately enhancing corrosion resistance and surface hardness of the aluminum alloy.

[0004] In addition to the enhancements in corrosion resistance and surface hardness of the aluminum alloy as mentioned above, the anodic oxidation method enables the anodic oxide film to be colored via adsorption with a dye. Hence, this metal surface treatment method is widely useful.

[0005] As for conventional anodic oxidation, however, as the anodic oxidation time increases, the surface gloss of the aluminum alloy may decrease. Even when the surface of the aluminum alloy having low gloss is subjected to polishing after anodic oxidation, it is difficult to ensure a high-gloss surface of the aluminum alloy.

[0006] With the aim of alleviating these problems, Korean Patent Application Publication No. 10-2005-0118918, entitled "A surface treatment method of aluminum and white-board product thereby", includes a pretreatment process for immersing an aluminum sheet in a mixed aqueous solution of acidic ammonium fluoride and calcium gluconate.

[0007] Also, Korean Patent No. 10-0864316, entitled "Method of chemical treatment for surface of aluminum pipe for organic photo conductor drum", discloses an increase in gloss of the aluminum pipe, including immersing the aluminum pipe in a 5 ~ 20 % (w/v) ammonium fluoride solution containing 0.001 ~ 0.03 wt% of a hydrofluoric acid additive for 1 ~ 5 min so as to be acid-etched.

[0008] However, when the acidic ammonium fluoride

is used alone or in combination in the form of a mixed aqueous solution with calcium gluconate or hydrofluoric acid in this way, a white film may be obtained but may be opaque and dull, making it difficult to ensure a high-gloss surface of the aluminum alloy.

Disclosure**Technical Problem**

[0009] Accordingly, the present invention has been made keeping in mind the above problems encountered in the related art, and an object of the present invention is to provide a method of surface-treating an aluminum alloy, wherein scratches and grinding pad marks generated on the surface of an aluminum alloy by mechanical grinding may be effectively removed, and a high-gloss surface of the aluminum alloy may be obtained, regardless of anodic oxidation time.

[0010] The objects of the present invention are not limited to the foregoing, and the other objects not mentioned herein will be able to be clearly understood to those skilled in the art from the following description.

Technical Solution

[0011] In order to accomplish the above object, an embodiment of the present invention provides a method of surface-treating an aluminum alloy, comprising: pretreating an aluminum alloy; immersing the pretreated aluminum alloy in an etching solution having a predetermined composition so that a surface of the aluminum alloy is etched, thus forming a transparent glossy film; subjecting the aluminum alloy having the transparent glossy film to anodic oxidation, thus forming an oxide film on the surface of the aluminum alloy; and post-treating the aluminum alloy having the oxide film.

[0012] Preferably, pretreating the aluminum alloy comprises: grinding the surface of the aluminum alloy; and immersing the ground aluminum alloy in a degreasing solution having a predetermined composition to remove impurities from the surface of the aluminum alloy.

[0013] Preferably, the degreasing solution is prepared by mixing 1 L of water and 3 ~ 10% of alkylamine ethoxylate or alcohol ethoxylate and 3 ~ 10% of sulfuric acid based on the total weight thereof, and the aluminum alloy is degreased by being immersed in the degreasing solution at 50 ~ 60°C for 3 ~ 10 min.

[0014] Preferably, the etching solution is prepared by heat-dissolving 45 ~ 475 g of acidic ammonium fluoride in a mixed solution resulting from mixing 1 L of water and 1 ~ 9% of boric acid based on the total weight thereof, and the aluminum alloy is etched by being immersed in the etching solution at room temperature for 1 ~ 10 min.

[0015] Preferably, forming the oxide film is performed by immersing the aluminum alloy in a sulfuric acid electrolytic solution at 20°C and then applying a voltage of 14 V for 50 min to form an oxide film having a thickness

of 20 ~ 22 μm .

[0016] Preferably, post-treating the aluminum alloy having the oxide film comprises: coloring and polishing the surface of the aluminum alloy having the oxide film; and sealing the colored and polished aluminum alloy.

Advantageous Effects

[0017] According to the present invention, scratches and grinding pad marks generated on the surface of an aluminum alloy by mechanical grinding can be effectively removed, and a high-gloss surface of the aluminum alloy can be obtained regardless of the anodic oxidation time.

Description of Drawings

[0018]

FIG. 1 illustrates a process of surface-treating an aluminum alloy according to an embodiment of the present invention; and

FIG. 2 schematically illustrates the surface of the aluminum or aluminum alloy before (a) and after (b) the third step of FIG. 1.

Best Mode

[0019] The terms used in the present invention are possibly selected from among currently well-known terms, some of the terms mentioned in the description of the present invention have been selected by the applicant, the detailed meanings of which should be understood not simply by the actual terms used but by the meaning of each term in the detailed description of the invention or in consideration of the meanings used.

[0020] Hereinafter, a detailed description will be given of the technical construction of the present invention with reference to preferred embodiments illustrated in the appended drawings.

[0021] In regard thereto, FIG. 1 illustrates a process of surface-treating an aluminum alloy according to an embodiment of the present invention, and FIG. 2 schematically illustrates the surface of the aluminum alloy before (a) and after (b) the third step of FIG. 1.

[0022] As illustrated in FIGS. 1 and 2, the method of surface-treating an aluminum alloy according to an embodiment of the present invention includes pretreating aluminum or an aluminum alloy prepared by extrusion or rolling.

[0023] As such, such pretreatment includes grinding the surface of the prepared aluminum alloy (S100) and immersing the ground aluminum alloy in a degreasing solution having a predetermined composition, thus degreasing the surface of the aluminum alloy to remove impurities therefrom (S200).

[0024] Below is a description of these pretreatment steps (S100 and S200).

[0025] Grinding the surface of the aluminum alloy

(S100) is a step (S100) of mechanically grinding the prepared aluminum or aluminum alloy using a variety of grinding agents including oil or fat grinding agents by means of any grinder, but the present invention is not particularly limited thereto.

[0026] After the step (S100) of grinding the surface of the aluminum alloy, impurities or grinding agent may remain on the surface of the aluminum or aluminum alloy due to the mechanical grinding. These impurities have to be removed.

[0027] In order to remove any impurities or remaining grinding agent, the method of surface-treating the aluminum alloy according to the embodiment of the present invention includes immersing the ground aluminum or aluminum alloy in a degreasing solution having a predetermined composition, and thereby the impurities or remaining grinding agent on the surface of the aluminum or aluminum alloy are removed by degreasing (S200).

[0028] As such, removing the impurities or remaining grinding agent by degreasing (S200) may be performed in such a manner that the impurities or remaining grinding agent are removed from the surface of the aluminum or aluminum alloy using a degreasing solution including various nonionic surfactants and sulfuric acid (H_2SO_4).

[0029] In a preferred embodiment of the present invention, the degreasing solution is prepared by mixing 1 L of water with 3 ~ 10% of alkylamine ethoxylate or alcohol ethoxylate and 3 ~ 10% of sulfuric acid based on the total weight thereof.

[0030] The aluminum or aluminum alloy is immersed in the degreasing solution under various temperatures and time conditions, thus removing the impurities or remaining grinding agent. In a preferred embodiment of the present invention, the aluminum or aluminum alloy is immersed in the degreasing solution at 50 ~ 60°C for 3 ~ 10 min to remove any impurities or remaining grinding agent.

[0031] Also, removing the impurities or remaining grinding agent by degreasing (S200) may be effectively implemented by applying ultrasonic waves or vibration to the aluminum or aluminum alloy, which is immersed in the degreasing solution, or by shaking the degreasing solution.

[0032] Meanwhile, the aluminum or aluminum alloy prepared by rolling or extrusion has a rough surface due to the nature of the corresponding process. As such, limitations are imposed on the removal of such a rough surface by the mechanical grinding step (S100) and the degreasing step (S200).

[0033] Specifically, the rough surface may be removed to some extent by the mechanical grinding step (S100) and the degreasing step (S200). As illustrated in FIG. 2(a), however, fine grinding pad marks or scratches may be present after the degreasing step (S200).

[0034] Even when the surface of the aluminum or aluminum alloy including such fine grinding pad marks or scratches is further subjected to anodic oxidation and polishing, it is difficult to obtain a high-gloss surface.

[0035] After the degreasing step (S200), in order to remove fine grinding pad marks or scratches from the surface of the aluminum or aluminum alloy, the method of surface-treating the aluminum alloy according to the embodiment of the present invention includes immersing the aluminum or aluminum alloy in an etching solution having a predetermined composition, and thereby the fine grinding pad marks or scratches existing on the surface of the aluminum or aluminum alloy may be removed by etching, and simultaneously, a transparent glossy film as illustrated in FIG. 2(b) is formed (S300).

[0036] According to the embodiment of the present invention, the etching solution is prepared by heat-dissolving 45 ~ 475 g of acidic ammonium fluoride in a mixed solution resulting from mixing 1 L of water and 1 ~ 9% of boric acid based on the total weight thereof.

[0037] The acidic ammonium fluoride may be any one selected from among NH_4F , NH_4HF and NH_4HF_2 , and the boric acid is preferably ortho-boric acid that is represented by H_3BO_3 and is colorless, transparent or lustrous.

[0038] The reason why the etching solution comprising acidic ammonium fluoride and boric acid as above is used is as follows: when using a conventional etching solution comprising an acidic ammonium fluoride aqueous solution or a mixed aqueous solution of acidic ammonium fluoride and calcium gluconate or hydrofluoric acid, it is possible to obtain the surface of aluminum or an aluminum alloy without fine grinding pad marks or scratches.

[0039] However, when the surface of the aluminum or aluminum alloy is etched using such a conventional etching solution, it may become opaque and dull, thereby making it difficult to obtain a high-gloss surface of the aluminum or aluminum alloy. Hence, the etching solution comprising acidic ammonium fluoride and boric acid is useful.

[0040] Furthermore, forming the transparent glossy film (S300) may be performed under various temperature and time conditions.

[0041] In a preferred embodiment of the present invention, forming the transparent glossy film (S300) is conducted by immersing the aluminum or aluminum alloy in the etching solution at room temperature (about 25°C) for 1 ~ 10 min.

[0042] Also, the method of surface-treating the aluminum alloy according to the embodiment of the present invention includes subjecting the aluminum or aluminum alloy having the transparent glossy film to anodic oxidation, thus forming an oxide film at a predetermined thickness on the surface of the aluminum or aluminum alloy (S400).

[0043] Forming the oxide film (S400) may be implemented using an electrolytic solution comprising any one or a mixture of two or more selected from among sulfuric acid, oxalic acid and chromic acid.

[0044] In a preferred embodiment of the present invention, sulfuric acid (H_2SO_4) is used for the electrolytic solution to enhance profitability, transparency of the oxide

film, corrosion resistance, and wear resistance. The aluminum alloy is immersed in the sulfuric acid electrolytic solution at 20°C and a voltage of 14 V is then applied for 50 min, thus forming a 20 ~ 22 μm thick oxide film.

[0045] After the step (S400) of forming the oxide film, the method of surface-treating the aluminum alloy according to the embodiment of the present invention includes post-treating the aluminum or aluminum alloy.

[0046] As such, post-treatment may include coloring and polishing the surface of the aluminum alloy having the oxide film (S500) and sealing the colored and polished aluminum alloy (S600).

[0047] The aluminum or aluminum alloy may be variously colored via the coloring and polishing (S500), and the polishing process may be performed using any mechanical means, but the present invention is not limited thereto.

[0048] After the step (S500) of coloring and polishing, the method of surface-treating the aluminum alloy according to the embodiment of the present invention may include sealing the aluminum or aluminum alloy (S600).

[0049] The sealing step (S600) indicates a process of sealing micropores of the oxide film formed by anodic oxidation to thus modify the properties including corrosion resistance, etc.

[0050] The sealing step (S600) according to the embodiment of the present invention may be conducted using various sealing processes such as sealing by hydration, metal salt sealing and organic compound sealing.

[0051] In a preferred embodiment of the present invention, the sealing step (S600) is performed via metal salt sealing by immersing the aluminum or aluminum alloy having the oxide film in a metal salt aqueous solution.

[0052] As such, nickel is used for the metal salt, and the aluminum or aluminum alloy is immersed in a nickel salt aqueous solution at 60 ~ 80°C for 10 min, thus ensuring a high-gloss surface of the aluminum or aluminum alloy.

[0053] According to the embodiment or the preferred embodiment of the present invention, the method of surface-treating the aluminum alloy enables scratches and grinding pad marks generated on the surface of the aluminum or aluminum alloy by mechanical grinding to be effectively removed via the aforementioned steps.

[0054] Regardless of the anodic oxidation time, a high-gloss surface of the aluminum alloy may be obtained.

[0055] Although the preferred embodiment of the present invention has been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention.

Mode for Invention

[0056] Below is a detailed description of an embodiment of the present invention in conjunction with FIGS. 1 and 2.

[0057] Referring to FIGS. 1 and 2, a method of surface-treating an aluminum alloy according to an embodiment of the present invention includes pretreating aluminum or an aluminum alloy prepared by extrusion or rolling.

[0058] As such, the pretreating process includes grinding the surface of the prepared aluminum alloy (S100) and immersing the ground aluminum alloy in a degreasing solution having a predetermined composition to remove impurities remaining on the surface of the aluminum alloy by degreasing (S200).

[0059] These pretreatment steps (S100 and S200) are described in detail below.

[0060] Specifically, grinding the surface of the aluminum alloy (S100) is a step (S100) of mechanically grinding the prepared aluminum or aluminum alloy using a variety of grinding agents including oil or fat grinding agents.

[0061] After the step (S100) of grinding the surface of the aluminum alloy, impurities or grinding agent may be left behind on the surface of the aluminum or aluminum alloy due to the mechanical grinding. There is a need to remove these remaining impurities.

[0062] With the goal of removing the impurities or remaining grinding agent, immersing the ground aluminum or aluminum alloy in a degreasing solution having a predetermined composition is performed, so that the surface of the aluminum or aluminum alloy is degreased to remove the impurities or remaining grinding agent therefrom (S200).

[0063] As such, removal of the impurities or remaining grinding agent by degreasing (S200) may be carried out by removing the impurities or remaining grinding agent from the surface of the aluminum or aluminum alloy using a degreasing solution including a nonionic surfactant and sulfuric acid (H_2SO_4).

[0064] In the present invention, the degreasing solution may be prepared by mixing 1 L of water with 6.5% of alkylamine ethoxylate or alcohol ethoxylate and 6.5% of sulfuric acid on the total weight thereof.

[0065] The aluminum or aluminum alloy is immersed in the degreasing solution at 55°C for 6 min, thus removing the impurities or remaining grinding agent.

[0066] Also, removing the impurities or remaining grinding agent by degreasing (S200) may be effectively implemented by applying ultrasonic waves or vibration to the aluminum or aluminum alloy, which is immersed in the degreasing solution, or by shaking the degreasing solution.

[0067] Meanwhile, the aluminum or aluminum alloy prepared by rolling or extrusion has a rough surface due to the nature of the corresponding process. As such, the removal of such a rough surface by the mechanical grinding step (S100) and the degreasing step (S200) is limited.

[0068] Specifically, the rough surface may be removed to some extent by the mechanical grinding step (S100) and the degreasing step (S200). As illustrated in FIG. 2(a), however, fine grinding pad marks or scratches may be present after the degreasing step (S200).

[0069] Even when the surface of the aluminum or aluminum alloy including such fine grinding pad marks or scratches is further subjected to anodic oxidation and polishing, it is difficult to obtain a high-gloss surface.

[0070] After the degreasing step (S200), therefore, immersing the aluminum or aluminum alloy in an etching solution having a predetermined composition to remove fine grinding pad marks or scratches from the surface of the aluminum or aluminum alloy is performed, so that the fine grinding pad marks or scratches existing on the surface of the aluminum or aluminum alloy are removed by etching, and simultaneously, a transparent glossy film as illustrated in FIG. 2(b) is formed (S300).

[0071] According to the embodiment of the present invention, the etching solution may be prepared by heat-dissolving 260 g of acidic ammonium fluoride in a mixed solution resulting from mixing 1 L of water and 5% of boric acid based on the total weight thereof.

[0072] The acidic ammonium fluoride may include NH_4F , and the boric acid may be ortho-boric acid that is represented by H_3BO_3 and is colorless, transparent or lustrous.

[0073] The reason why the etching solution comprising acidic ammonium fluoride and boric acid as above is used is as follows: when using a conventional etching solution comprising an acidic ammonium fluoride aqueous solution or a mixed aqueous solution of acidic ammonium fluoride and calcium gluconate or hydrofluoric acid, it is possible to obtain the surface of aluminum or an aluminum alloy without fine grinding pad marks or scratches.

[0074] However, when the surface of the aluminum or aluminum alloy is etched using such a conventional etching solution, it may become opaque and dull, making it difficult to afford a high-gloss surface of the aluminum or aluminum alloy. Hence, the etching solution comprising acidic ammonium fluoride and boric acid is useful.

[0075] Furthermore, forming the transparent glossy film (S300) may be performed by immersing the aluminum or aluminum alloy in the etching solution at room temperature (25°C) for 5 min.

[0076] Then, subjecting the aluminum or aluminum alloy having the transparent glossy film to anodic oxidation to form an oxide film at a predetermined thickness on the surface of the aluminum or aluminum alloy (S400) is performed.

[0077] As such, forming the oxide film (S400) may be carried out using an electrolytic solution comprising sulfuric acid.

[0078] The aluminum alloy is immersed in the sulfuric acid electrolytic solution at 20°C, followed by applying a voltage of 14 V for 50 min, thus forming a 20 μm thick oxide film.

[0079] After the step (S400) of forming the oxide film, post-treating the aluminum or aluminum alloy is conducted.

[0080] As such, post-treatment may include coloring and polishing the surface of the aluminum alloy having the oxide film (S500) and sealing the colored and pol-

ished aluminum alloy (S600).

[0081] After the step (S500) of coloring and polishing, sealing the aluminum or aluminum alloy (S600) is carried out.

[0082] The sealing step (S600) is conducted via metal salt sealing in such a manner that the aluminum or aluminum alloy having the oxide film is immersed in a metal salt aqueous solution.

[0083] As such, nickel is used for the metal salt, and the aluminum or aluminum alloy is immersed in a nickel salt aqueous solution at 70°C for 10 min, thereby ensuring a high-gloss surface of the aluminum or aluminum alloy.

[0084] Consequently, the aforementioned steps of the method of surface-treating the aluminum alloy according to the present invention are effective at removing scratches and grinding pad marks generated on the surface of the aluminum or aluminum alloy by mechanical grinding.

[0085] Moreover, the aluminum alloy may have a high-gloss surface, regardless of the anodic oxidation time.

Industrial Applicability

[0086] According to the present invention, a method of surface-treating an aluminum alloy can effectively remove scratches and grinding pad marks generated by mechanical grinding.

[0087] Also, regardless of anodic oxidation time, an aluminum alloy having high gloss can be manufactured, and thus the present invention is industrially applicable.

Claims

1. A method of surface-treating an aluminum alloy, 35 comprising:

pretreating an aluminum alloy;
immersing the pretreated aluminum alloy in an etching solution having a predetermined composition so that a surface of the aluminum alloy is etched, thus forming a transparent glossy film;
subjecting the aluminum alloy having the transparent glossy film to anodic oxidation, thus forming an oxide film on the surface of the aluminum alloy; and
post-treating the aluminum alloy having the oxide film.

2. The method of claim 1, wherein pretreating the aluminum alloy comprises:

grinding the surface of the aluminum alloy; and
immersing the ground aluminum alloy in a degreasing solution having a predetermined composition to remove impurities from the surface of the aluminum alloy.

3. The method of claim 2, wherein the degreasing solution is prepared by mixing 1 L of water and 3 ~ 10% of alkylamine ethoxylate or alcohol ethoxylate and 3 ~ 10% of sulfuric acid based on a total weight thereof, and the aluminum alloy is degreased by being immersed in the degreasing solution at 50 ~ 60°C for 3 ~ 10 min.

4. The method of claim 1, wherein the etching solution is prepared by heat-dissolving 45 ~ 475 g of acidic ammonium fluoride in a mixed solution resulting from mixing 1 L of water and 1 ~ 9% of boric acid based on a total weight thereof, and the aluminum alloy is etched by being immersed in the etching solution at room temperature for 1 ~ 10 min.

5. The method of claim 1, wherein forming the oxide film is performed by immersing the aluminum alloy in a sulfuric acid electrolytic solution at 20°C and then applying a voltage of 14 V for 50 min to form the oxide film having a thickness of 20 ~ 22 µm.

6. The method of claim 1, wherein post-treating the aluminum alloy having the oxide film comprises:

coloring and polishing the surface of the aluminum alloy having the oxide film; and
sealing the colored and polished aluminum alloy.

25

30

35

40

45

55

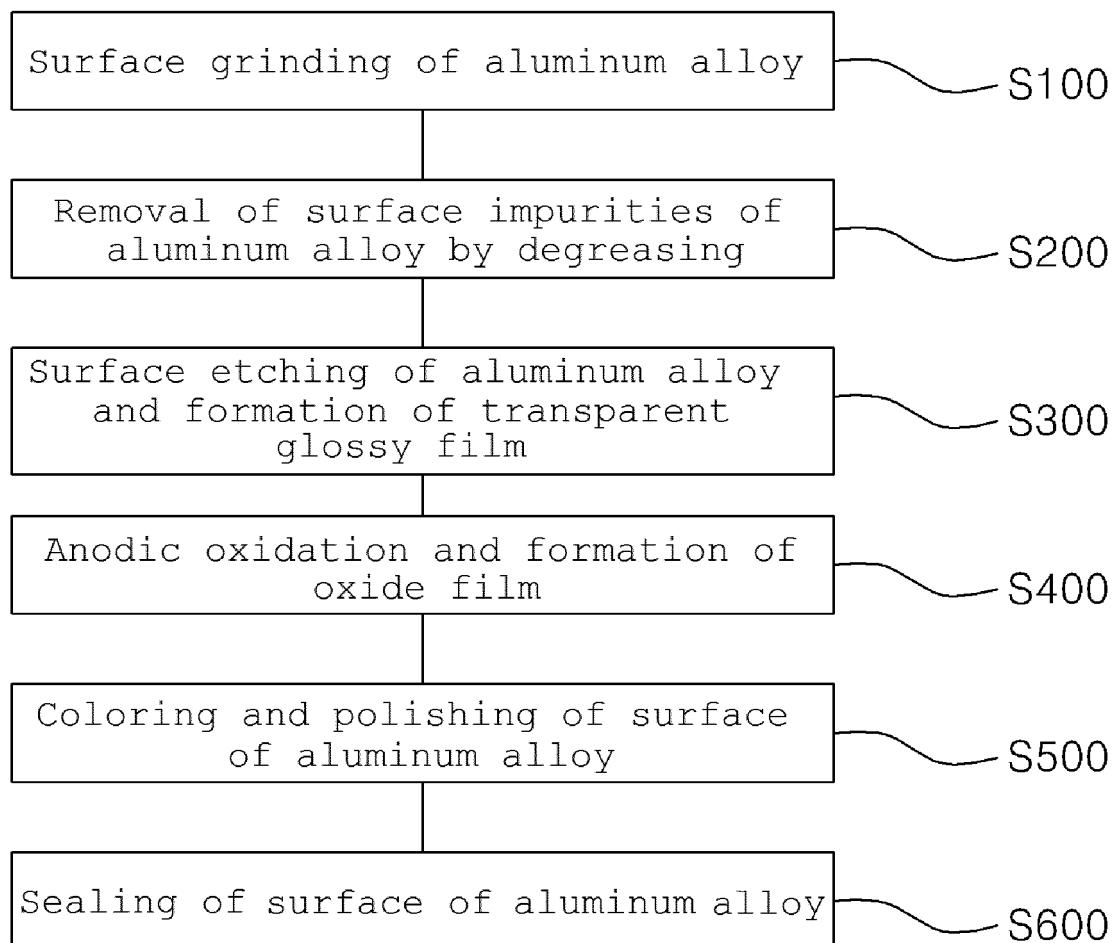


FIG. 1

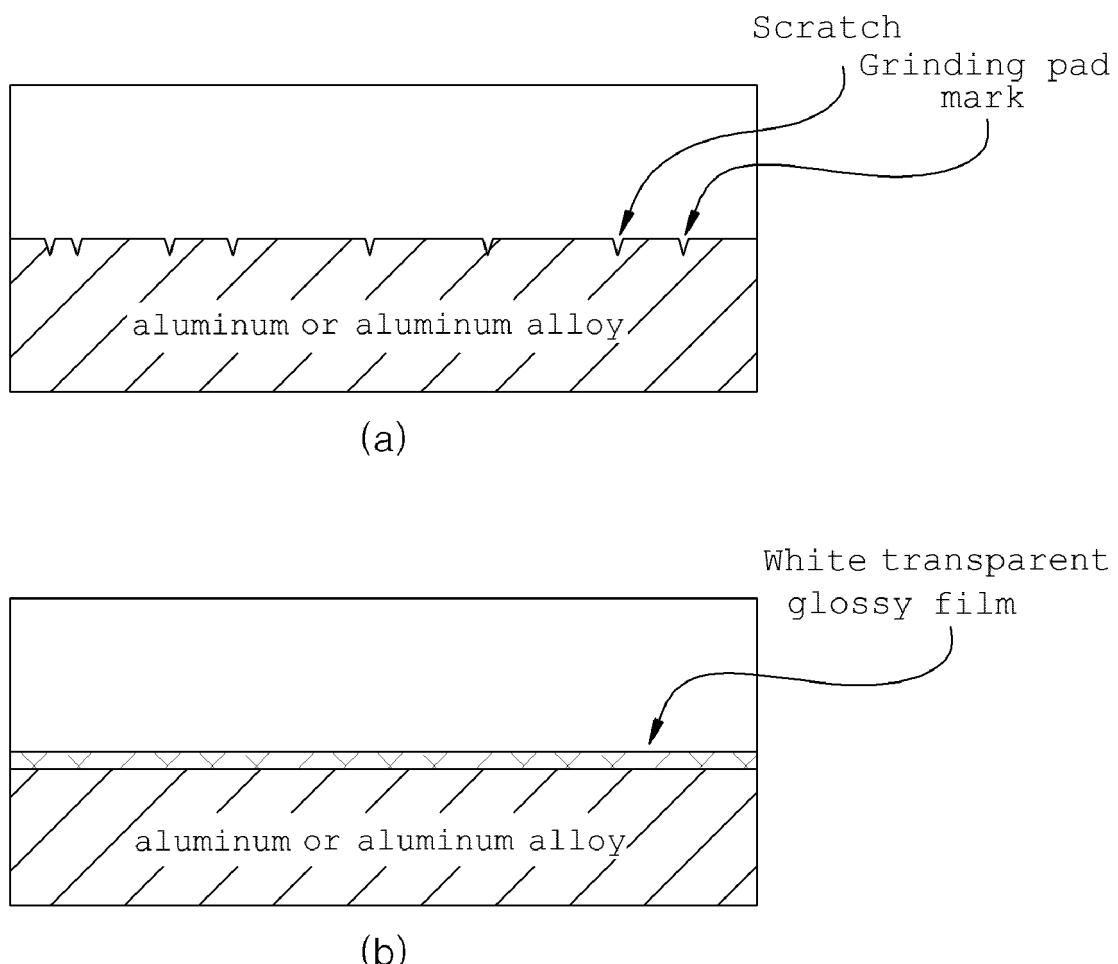


FIG. 2

INTERNATIONAL SEARCH REPORT		International application No. PCT/KR2014/005119																					
5	A. CLASSIFICATION OF SUBJECT MATTER C25D 11/04(2006.01)i, C25D 11/16(2006.01)i, C25D 11/18(2006.01)i According to International Patent Classification (IPC) or to both national classification and IPC																						
10	B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) C25D 11/04; C25D 11/16; A47J 36/02; C25D 11/14; A47J 36/00; C22C 23/00; C22C 21/06; C23F 1/20; C25D 11/22; C25D 11/18																						
15	Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Korean Utility models and applications for Utility models: IPC as above Japanese Utility models and applications for Utility models: IPC as above																						
20	Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) eKOMPASS (KIPO internal) & Keywords: aluminum alloy, surface treatment, pretreatment, after treatment, anodic oxidation method, gloss film, oxide film, etchant																						
25	C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; padding: 2px;">Category*</th> <th style="text-align: left; padding: 2px;">Citation of document, with indication, where appropriate, of the relevant passages</th> <th style="text-align: left; padding: 2px;">Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; padding: 2px;">Y</td> <td style="padding: 2px;">KR 10-2010-0085704 A (HAN, Jang Kyu) 29 July 2010 See abstract; paragraphs [0020], [0021], [0032]-[0039]; claims 1-3; and figure 1.</td> <td style="text-align: center; padding: 2px;">1-3,5,6</td> </tr> <tr> <td style="text-align: center; padding: 2px;">A</td> <td style="padding: 2px;"></td> <td style="text-align: center; padding: 2px;">4</td> </tr> <tr> <td style="text-align: center; padding: 2px;">Y</td> <td style="padding: 2px;">JP 2001-059200 A (NIPPON LIGHT METAL CO., LTD.) 06 March 2001 See abstract; paragraph [0008]; and claims 1-5.</td> <td style="text-align: center; padding: 2px;">1-3,5,6</td> </tr> <tr> <td style="text-align: center; padding: 2px;">A</td> <td style="padding: 2px;">KR 10-2009-0058068 A (KIM, Seon Gu) 09 June 2009 See abstract; paragraph [0012]; claim 1; and figure 2.</td> <td style="text-align: center; padding: 2px;">1-6</td> </tr> <tr> <td style="text-align: center; padding: 2px;">A</td> <td style="padding: 2px;">KR 10-2009-0051271 A (ULVAC, INC. et al.) 21 May 2009 See abstract; paragraphs [0035]-[0052]; and claims 1-3.</td> <td style="text-align: center; padding: 2px;">1-6</td> </tr> <tr> <td style="text-align: center; padding: 2px;">A</td> <td style="padding: 2px;">JP 2003-003295 A (AISIN KEIKINZOKU CO., LTD.) 08 January 2003 See abstract; paragraphs [0015], [0023]; and claims 1, 2.</td> <td style="text-align: center; padding: 2px;">1-6</td> </tr> </tbody> </table>		Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	Y	KR 10-2010-0085704 A (HAN, Jang Kyu) 29 July 2010 See abstract; paragraphs [0020], [0021], [0032]-[0039]; claims 1-3; and figure 1.	1-3,5,6	A		4	Y	JP 2001-059200 A (NIPPON LIGHT METAL CO., LTD.) 06 March 2001 See abstract; paragraph [0008]; and claims 1-5.	1-3,5,6	A	KR 10-2009-0058068 A (KIM, Seon Gu) 09 June 2009 See abstract; paragraph [0012]; claim 1; and figure 2.	1-6	A	KR 10-2009-0051271 A (ULVAC, INC. et al.) 21 May 2009 See abstract; paragraphs [0035]-[0052]; and claims 1-3.	1-6	A	JP 2003-003295 A (AISIN KEIKINZOKU CO., LTD.) 08 January 2003 See abstract; paragraphs [0015], [0023]; and claims 1, 2.	1-6
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.																					
Y	KR 10-2010-0085704 A (HAN, Jang Kyu) 29 July 2010 See abstract; paragraphs [0020], [0021], [0032]-[0039]; claims 1-3; and figure 1.	1-3,5,6																					
A		4																					
Y	JP 2001-059200 A (NIPPON LIGHT METAL CO., LTD.) 06 March 2001 See abstract; paragraph [0008]; and claims 1-5.	1-3,5,6																					
A	KR 10-2009-0058068 A (KIM, Seon Gu) 09 June 2009 See abstract; paragraph [0012]; claim 1; and figure 2.	1-6																					
A	KR 10-2009-0051271 A (ULVAC, INC. et al.) 21 May 2009 See abstract; paragraphs [0035]-[0052]; and claims 1-3.	1-6																					
A	JP 2003-003295 A (AISIN KEIKINZOKU CO., LTD.) 08 January 2003 See abstract; paragraphs [0015], [0023]; and claims 1, 2.	1-6																					
35																							
40	<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.																						
45	* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed																						
50	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family																						
55	Date of the actual completion of the international search 08 OCTOBER 2014 (08.10.2014)																						
	Date of mailing of the international search report 13 OCTOBER 2014 (13.10.2014)																						
	Name and mailing address of the ISA/KR  Korean Intellectual Property Office Government Complex-Daejeon, 189 Seonsa-ro, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140																						
	Authorized officer Telephone No.																						

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2014/005119

Patent document cited in search report	Publication date	Patent family member	Publication date
KR 10-2010-0085704 A	29/07/2010	NONE	
JP 2001-059200 A	06/03/2001	JP 04048462 B2	20/02/2008
KR 10-2009-0058068 A	09/06/2009	NONE	
KR 10-2009-0051271 A	21/05/2009	CN 101522938 A CN 101522938 B JP 04790812 B2 TW 200835815 A TW I411703 B US 2010-0096044 A1 US 8617321 B2 WO 2008-041701 A1	02/09/2009 10/08/2011 12/10/2011 01/09/2008 11/10/2013 22/04/2010 31/12/2013 10/04/2008
JP 2003-003295 A	08/01/2003	JP 03672506 B2	20/07/2005

Form PCT/ISA/210 (patent family annex) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- KR 1020050118918 [0006]
- KR 100864316 [0007]