METHOD FOR MANUFACTURING ALUMINUM ROOF MOLDING USING POROUS OXIDE LAYER

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ABSTRACT

Disclosed is a method of manufacturing an aluminum roof molding using porous oxide layer comprising: forming a porous oxide layer on a surface of the aluminum material by anodizing the aluminum material; slitting the aluminum material on which the porous oxide layer is formed; rolling the aluminum material to a shape of the roof molding; heating the rolled formed aluminum material with a high frequency; and forming a PVC layer on the heated aluminum material and simultaneously extruding the aluminum material to bind the PVC layer to the aluminum material.

Diagrams:
- S100: Anodizing (forming porous oxide layer)
- S110: Rolling
- S120: High frequency heating
- S130: Extrusion
- S140: Bending
- S150: Assembling
FIG. 3
Prior Art

FIG. 4

S100  S110  S120  S130  S140  S150
ANODIZING  ROLL  HIGH FREQUENCY  EXTRUSION  SENDING  ASSEMBLING
(FORMING POROUS  FORMING  HEATING  EXTRUSION  SENDING  ASSEMBLING
OXIDE LAYER)
FIG. 7

S200  S210  S220  S230  S240  S250
DEGREASING  ETCHING  ACTIVATION  COATING  SEALING  DRYING

FIG. 8

Prior Art
method for manufacturing aluminum roof molding using porous oxide layer

cross-reference to related application


background

[0002] (a) Technical Field

[0003] The present invention relates to a method of manufacturing an aluminum roof molding using a porous oxide layer, and more particularly, to a method of manufacturing aluminum roof molding using a porous oxide layer, including forming a porous oxide layer on a surface of an aluminum material by anodizing the aluminum material and binding a Poly Vinyl Chloride (hereinafter, called as PVC) layer on the porous oxide layer without using chemicals such as adhesives.

[0004] (b) Background Art

[0005] FIG. 1 is an exemplary view showing an aluminum roof molding applicable to vehicles and FIG. 2 is an exemplary view illustrating a cross section of an aluminum roof molding wherein as shown in the drawings, an aluminum roof molding 100 is formed by combining an aluminum material 200 and a PVC layer 210 and covering a soldering portion of a roof panel and a side panel to enhance the appearance of the roof.

[0006] FIG. 3 is an exemplary sectional view illustrating an aluminum roof molding formed using adhesives according to a related art wherein the aluminum roof molding is manufactured by roll forming an aluminum material (e.g., A 5052) having the composition shown in Table 1 below, forming a PVC layer 210 on the applied adhesives 220 and extrusion molding the aluminum material.

<table>
<thead>
<tr>
<th>Description</th>
<th>Cr (wt %)</th>
<th>Cu (wt %)</th>
<th>Fe (wt %)</th>
<th>Mg (wt %)</th>
<th>Mn (wt %)</th>
<th>Si (wt %)</th>
<th>Ti (wt %)</th>
<th>Zn (wt %)</th>
<th>Rem.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS052</td>
<td>0.15-0.35</td>
<td>0.1 or less</td>
<td>0.4 or less</td>
<td>2.2-2.8</td>
<td>0.1 or less</td>
<td>0.25 or less</td>
<td>0.015 or less</td>
<td>0.1 or less</td>
<td>---</td>
</tr>
</tbody>
</table>

[0007] According to the related art, adhesives are required to manufacture an aluminum roof molding which may increase manufacturing costs. Further, durability of the aluminum roof molding is determined depending on the performance of the adhesive, making it difficult to predict the quality of the final product. In addition, the solidification time of the liquid type adhesives increases the process time, increasing entire process time.

[0008] Moreover, the adhesives generally have inferior water resistance and heat resistance, and thus the PVC layer bound to the aluminum material is easily separated from the aluminum material.

[0009] The description provided above as a related art of the present invention is just for helping understanding the background of the present invention and should not be construed as being included in the related art known by those skilled in the art.

summary of the disclosure

[0010] The present invention provides a method for manufacturing an aluminum roof molding using a porous oxide layer, and the method includes: forming a porous oxide layer on a surface of the aluminum material by anodizing the aluminum material; slitting the aluminum material on which the porous oxide layer is formed and roll forming the aluminum material to a shape of the roof molding; heating the roll formed aluminum material with a high frequency; and forming a PVC layer on the heated aluminum material and simultaneously extruding the aluminum material to bind the PVC layer to the aluminum material.

[0011] Further, the method for manufacturing an aluminum roof molding using a porous oxide layer according to an exemplary embodiment of the present invention further includes: bending the extruded aluminum material; and assembling an end piece and a clip to the bent aluminum material.

[0012] Additionally, the heating of the roll formed aluminum material may be performed at a temperature range of about 100 to 150 °C, to facilitate the combination of the aluminum material with a PVC layer. Further, the forming of the PVC layer is performed by extrusion, applying about 50 to 100 kgf/cm² of pressure.

[0013] Meanwhile, the anodizing treatment includes: degreasing the aluminum material; etching the degreased aluminum material; activating the etched aluminum material; coating the activated aluminum material; sealing the coated aluminum material; and drying the sealed aluminum material.

[0014] Further, the activation of the etched aluminum material is performed by heating the etched aluminum material with a high frequency. In addition, the high frequency heating is performed at about 200 to 300 kHz of alternating current frequency and about 100 to 200 V of voltage for about 1 to 3 minutes. Additionally, the anodizing is performed at about 100 to 300 V of voltage and about 100 to 200 mA/cm² of current density.

brief description of the drawings

[0015] The above and other features and advantages of the present invention will now be described in detail with reference to exemplary embodiments thereof illustrated by the accompanying drawings which are given hereinbelow by way of illustration only, and thus are not limiting of the present invention, and wherein:

[0016] FIG. 1 is an exemplary view showing an aluminum roof molding applicable to vehicles, according to the related art;

[0017] FIG. 2 is an exemplary sectional view illustrating an aluminum roof molding, according to the related art;

[0018] FIG. 3 is an exemplary sectional view illustrating an aluminum roof molding using adhesives according to the related art;
FIG. 4 is an exemplary flow chart of the aluminum roof molding processes according to an exemplary embodiment of the present invention;

FIG. 5 is an exemplary diagram showing a process for combining a PVC layer to the aluminum material according to an exemplary embodiment of the present invention;

FIG. 6 is an exemplary enlarged photo showing the composite layer 240 according to an exemplary embodiment of the present invention;

FIG. 7 is an exemplary flow chart of an anodizing treatment according to an exemplary embodiment of the present invention;

FIG. 8 is an exemplary enlarged photo showing an oxide layer produced by an anodizing treatment according to the related art;

FIG. 9 is an exemplary enlarged photo showing a porous oxide layer produced by anodizing treatment according to an exemplary embodiment of the present invention; and

FIG. 10 is an exemplary photo showing a comparison of accelerated weatherproof test results between an aluminum roof molding using adhesives (upper side) according to the related art and an aluminum roof molding produced according to an exemplary embodiment of the present invention (lower side).

It should be understood that the accompanying drawings are not necessarily to scale, presenting a somewhat simplified representation of various exemplary features illustrative of the basic principles of the invention. The specific design features of the present invention as disclosed herein, including, for example, specific dimensions, orientations, locations, and shapes will be determined in part by the particular intended application and use environment.

In the figures, reference numbers refer to the same or equivalent parts of the present invention throughout the several figures of the drawing.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENT

It is understood that the term “vehicle” or “vehicular” or other similar term as used herein is inclusive of motor vehicles in general such as passenger automobiles including sports utility vehicles (SUV), buses, trucks, various commercial vehicles, watercraft including a variety of boats and ships, aircraft, and the like, and includes hybrid vehicles, electric vehicles, combustion, plug-in hybrid electric vehicles, hydrogen-powered vehicles and other alternative fuel vehicles (e.g., fuels derived from resources other than petroleum).

The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms “a”, “an” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms “comprises” and/or “comprising,” when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof. As used herein, the term “and/or” includes any and all combinations of one or more of the associated listed items.

Unless specifically stated or obvious from context, as used herein, the term “about” is understood as within a range of normal tolerance in the art, for example within 2 standard deviations of the mean. “About can be understood as within 10%, 9%, 8%, 7%, 6%, 5%, 4%, 3%, 2%, 1%, 0.5%, 0.1%, 0.05%, or 0.01% of the stated value. Unless otherwise clear from the context, all numerical values provided herein are modified by the term “about.”

Hereinafter, the present invention now will be described in detail with reference to the accompanying drawings.

FIG. 4 is an exemplary flow chart of the aluminum roof molding according to an exemplary embodiment of the present invention. As shown in FIG. 4, an aluminum material (e.g., A5052 material quality) may be cut and the cut aluminum material may be anodized to form a porous oxide layer on a surface of the aluminum material (S100). The anodizing process is a surface treatment performed in solutions such as sulfuric acid, boric acid, etc. by applying direct or alternative current, or both with the metal to be plated as a positive electrode to form an anodizing layer (e.g., A1203) on a surface of the metal to be plated. Generally, the aluminum material used for vehicles is cut into a plate with a thickness of about 0.5 to 0.8 mm and a length of about 500 to 1250 mm.

Further, the aluminum material on which the porous oxide layer is formed may be slit and the slit aluminum material may be roll formed to a shape of a roof molding (S110). The roll formed aluminum material may be heated to a temperature range of about 100-150°C with a high frequency to facilitate a combination with a PVC layer (S120).

Upon heating the roll formed aluminum material with high frequency, the PVC layer may be formed on a surface of the heated aluminum material, and may be extruded simultaneously by passing the material through an extrusion mold to bind the PVC layer to the aluminum material, wherein for sufficient bonding, a pressure of about 50-100 kgf/cm² may be applied, and as a result, heterogeneous materials may be combined through the PVC being filled between gaps of the porous oxide layer formed in the step S100 (S130).

FIG. 5 is an exemplary schematic diagram showing a process for binding a PVC layer to the aluminum material. As shown in FIG. 5, the aluminum material 200 on which porous oxide layer 230 is formed on a surface by step S100 may be heated with high frequency in step S120.

Further, the PVC layer 210 may be formed on the porous oxide layer 230 and may be simultaneously extruded using an extrusion mold wherein the PVC is filled into the empty space of the porous oxide layer (e.g., gap of the rugged part) to form a composite layer 240, and as a result the combination is completed.

FIG. 6 is an exemplary enlarged photo showing the composite layer 240 and the PVC filled into the gap of the aluminum oxide layer 231.

In addition, the extruded aluminum material may be bent into a shape for the roof applicable to vehicle (S140), and the aluminum roof molding may be manufactured completely by assembling other contingent parts such as an end piece, a clip, etc. (S150).

As described above, according to the present invention, a method for combining heterogeneous material of aluminum and PVC through compression using the extrusion mold without using adhesives is provided wherein a porous layer may be formed by anodizing.

In other words, an object of the conventional anodizing is to create a smooth surface by anodizing under a proper condition; the object of the anodizing of the present invention is to produce a porous oxide layer having fine spaces to be filled with the PVC by maximizing anodizing reaction.
TABLE 2

<table>
<thead>
<tr>
<th>process</th>
<th>Composition (solution)</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degreasing</td>
<td>Na₃PO₄ 30 g/L</td>
<td>Cathode Degreasing for 0.5-3 minutes, at current density of 1-4 A/cm², 4-6 V.</td>
</tr>
<tr>
<td>Etching</td>
<td>CrO₃ 180 g/L</td>
<td>Immersion for 3 minutes at 20-30°C.</td>
</tr>
<tr>
<td>Activation</td>
<td>—</td>
<td>High Frequency Heating, Frequency 200-300 kHz, Voltage 100-200 V, Immersion for 1-3 minutes</td>
</tr>
<tr>
<td>Coating</td>
<td>Na₂SO₄⋅9H₂O 10-15 g/L</td>
<td>Temperature: 30-40°C.</td>
</tr>
<tr>
<td></td>
<td>KF 2H₂O 3-5 g/L</td>
<td>Voltage: 100-300 V</td>
</tr>
<tr>
<td></td>
<td>KOH 2-4 g/L</td>
<td>Current Density: 100-200 mA/cm², Duration: 1-2 minutes</td>
</tr>
<tr>
<td>Sealing</td>
<td>Ethylene</td>
<td>Immersion for 1 minute at 20-30°C.</td>
</tr>
<tr>
<td>Drying</td>
<td>—</td>
<td>Maintaining for 10-20 minutes at 90 ± 10°C.</td>
</tr>
</tbody>
</table>

The above Table 2 shows detailed conditions to form a porous oxide layer on the surface of the aluminum material in anodizing treatment, and FIG. 7 is an exemplary flow chart showing the anodizing according to an exemplary embodiment of the present invention.

As shown in FIG. 7, the aluminum material may be degreased by removing fatty contamination on the surface thereof (S200), and the surface of the degreased aluminum material may be etched to improve close adhesiveness with the oxide layer to be formed (S210). Moreover, the etched aluminum material may be activated, which is a pre-treatment process to destroy passivation of the surface, to facilitate the generation of the oxide layer on the surface (S220).

In a conventional anodizing treatment, the activation is performed by immersing the aluminum material into 2-4 g/L of potassium hydroxide (KOH) of an alkaline solution at 20-30°C to prevent excessive anodizing reaction through adjusting the anodizing reaction properly. Unlike the conventional treatment, the present invention provides a method wherein the activation of the aluminum material may be performed by embedding the materials in two plates through which alternative current of high frequency may flow to maximize the anodizing reaction and by heating the material with high frequency (e.g., using electromagnetic induction phenomenon).

Specifically, as a pre-treatment process for porosity of the oxide layer, the high frequency heating according to the present invention may be executed by heating the embedded aluminum material for about 1-3 minutes at about 200-300 kHz of alternative current frequency and about 100-200 V of voltage wherein the surface temperature of the aluminum material may be maintained within a temperature range of about 100-200°C.

After the activation, the coating may be performed to produce a porous oxide layer (S230). The electrolyte used in the coating step (S230) may comprise one or more of Sodium Silicate (Na₂SiO₃), Potassium Fluoride (KF) and Potassium Hydroxide (KOH). Alternatively, the electrolyte may comprise all of Sodium Silicate 9 Hydrates (Na₂SiO₃...9H₂O), Potassium Fluoride 2 Hydrates (KF...2H₂O) and Potassium Hydroxide (KOH).

The electrolyte may accelerate ionization of the water, and more specifically, a coating layer of anodizing aluminum oxide (Al₂O₃) may be formed by following chemical reactions (1) and (2);

\[ 2H₂O \rightarrow 2OH^- + H₂↑ \]  

(1)  

\[ 2Al + 3OH^- \rightarrow Al₂O₃ + 3H₂\]  

(2)  

Moreover, the anodizing reaction may be performed at a high current density and a high voltage, wherein the anodizing reaction may be performed at about 100-300 V of voltage and about 100-200 mA/cm² of current density to form a porous layer of a desired level.

FIG. 8 is an exemplary enlarged photo showing an oxide layer produced by an anodizing treatment according to a prior art, and FIG. 9 is an exemplary enlarged photo showing a porous oxide layer produced by anodizing treatment according to an exemplary embodiment of the present invention. As shown in the photos, the oxide layer produced by the method of the present invention is a porous layer.

Furthermore, a sealing treatment may be performed by filling the vesicles of the coated aluminum material. The sealing treatment may be performed to improve corrosion resistance of the aluminum material and stabilize the produced porous oxide layer due to the activity in the anodizing oxide layer in an initial stage of formation which may become inactive and placed in a contaminated state due to the absorption of gases in the air, etc., (S240).

In addition, the sealed aluminum material may be dried to firmly combine the produced porous layer and to evaporate the solution, thereby completing the formation of the porous layer.

FIG. 10 is an exemplary photo showing a comparison of anodized and non-anodized parts of an aluminum material located in the lower side and in the upper side, respectively, according to a prior art and an aluminum material according to the present invention, respectively, in a different area of the anodized aluminum material.

As described above, an aluminum metal and a PVC layer may be combined with adhesives according to a prior art, but according to the present invention, a porous oxide layer may be formed on the surface of the aluminum and a PVC layer may be bound with the aluminum material using the oxide layer without the adhesive thereby improving adhesiveness.

The method of manufacturing an aluminum roof molding of the present invention may be performed by mechanically compressing the PVC on the aluminum material using porosity of the aluminum oxide layer formed by anodizing to omit the process of using adhesives. In addition, the method of the present invention may improve heat resistance, water resistance, durability, etc., by binding the PVC layer on the surface of the aluminum material without using...
adhesives vulnerable to heat or moisture. Moreover, the gap of a porous oxide layer on the surface of the aluminum material formed by the method of the present invention may be filled with the PVC so the adhesiveness of the heterogeneous material may be improved.

The invention has been described in detail with reference to exemplary embodiments thereof. However, it will be appreciated by those skilled in the art that changes or modifications may be made in these embodiments without departing from the principles and spirit of the invention, the scope of which is defined in the accompanying claims and their equivalents.

What is claimed is:

1. A method for manufacturing an aluminum roof molding using a porous oxide layer, comprising:
   - forming the porous oxide layer on a surface of an aluminum material by anodizing the aluminum material;
   - slitting the aluminum material on which the porous oxide layer is formed;
   - roll forming the aluminum material to a shape of the roof molding;
   - heating the roll formed aluminum material with a high frequency;
   - forming a PVC layer on the heated aluminum material and simultaneously extruding the aluminum material to bind the PVC layer to the aluminum material.

2. The method for manufacturing an aluminum roof molding using porous oxide layer of claim 1, further comprising:
   - bending the extruded aluminum material; and
   - assembling an end piece and a clip to the bent aluminum material.

3. The method for manufacturing an aluminum roof molding using porous oxide layer of claim 1, further comprising:
   - heating the roll formed aluminum material with the high frequency at a temperature range of about 100 to 150°C, to facilitate the binding of the aluminum material with the PVC layer.

4. The method for manufacturing an aluminum roof molding using porous oxide layer of claim 1, wherein the extruding of the aluminum material further comprises: applying about 50 to 100 kgf/cm² of pressure.

5. The method for manufacturing an aluminum roof molding using porous oxide layer of claim 1, wherein the anodizing further comprises:
   - degreasing the aluminum material;
   - etching the degreased material aluminum material;
   - activating the etched aluminum material;
   - coating the activated aluminum material;
   - sealing the coated aluminum material; and
   - drying the sealed aluminum material.

6. The method for manufacturing an aluminum roof molding using porous oxide layer of claim 5, wherein activating the etched aluminum material further comprises: heating the etched aluminum material with the high frequency.

7. The method for manufacturing an aluminum roof molding using porous oxide layer of claim 6, wherein the high frequency heating is performed using about 200 to 300 kHz of alternative current frequency and about 100 to 200 V of voltage for about 1 to 3 minutes.

8. The method for manufacturing an aluminum roof molding using porous oxide layer of claim 5, wherein the anodizing is performed using about 100 to 300 V of voltage and about 100 to 200 mA/cm² of current density.

9. A method for manufacturing an aluminum roof molding using a porous oxide layer, comprising:
   - forming the porous oxide layer on a surface of an aluminum material by anodizing the aluminum material;
   - in response to forming the porous oxide layer, slitting the aluminum material on which the porous oxide layer is formed;
   - in response to slitting the aluminum material, roll forming the aluminum material to a shape of the roof molding;
   - in response to roll forming the aluminum material, heating the roll formed aluminum material with a high frequency; and
   - in response to heating the roll formed aluminum material, forming a PVC layer on the heated aluminum material and simultaneously extruding the aluminum material to bind the PVC layer to the aluminum material.

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