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PRODUCING ETCHED SURFACES ON ALUMINUM

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This invention relates to the production of etched aluminum surfaces, and particularly to the production of etched surfaces having uniform reflecting properties and brightness on copper-free aluminum.

Etched aluminum surfaces have found wide application on articles used as light reflectors, engraved name plates, and more recently for reflectors used for the reflection of ultra violet radiation. A solution of sodium hydroxide has been extensively used for producing this type of surface. The common procedure is to etch the aluminum surface in a hot solution of sodium hydroxide, then dip the article in nitric acid, and subsequently wash and dry. It is known that in order to obtain a uniform etch and bright surface by this process, the aluminum to be etched should contain a small amount of copper, the best results being obtained by etching aluminum containing about 0.1 to 0.2 per cent copper. When aluminum surfaces containing only a few hundredths of one per cent copper are treated in this manner, the etch obtained is frequently nonuniform and the surface appears hazy and streaked. This difficulty becomes more pronounced as the copper content of the aluminum treated decreases below about 0.05 per cent.

It is an object of this invention to overcome the difficulties heretofore encountered in the etching of copper-free aluminum surfaces, and to produce copper-free aluminum articles having uniformly etched surfaces of high reflectivity and having a high metallic lustre.

It is a further object of this invention to provide a method of etching articles having surfaces of copper-free aluminum whereby there is produced thereon a uniform reflecting surface substantially free from haze and streaks. It is a further object of this invention to produce an improved etching solution for application to copper-free aluminum to produce thereon an etched reflecting surface of uniform reflectivity and brightness.

Copper is generally present as an impurity in commercial aluminum. The term "copper-free aluminum" used herein in describing this invention and in the appended claims contemplates, therefore, both aluminum and aluminum alloys completely free of copper, and aluminum and aluminum alloys containing less than about 0.05 per cent copper as an impurity.

I have discovered that when a copper-free aluminum surface is etched in a solution of an alkali to which certain metallic salts have been added, the surface can be uniformly etched to produce a surface substantially free from any streaked or hazy appearance and having a uniform reflectivity and brightness and a high metallic lustre.

In practicing my invention, the article having a copper-free aluminum surface is immersed in a hot solution containing an alkali, such as sodium or potassium hydroxide or carbonate, a compound of a metal such as copper or cobalt, and, if necessary, a reagent adapted to hold the metal compound in solution. The concentration of the caustic etching solution is not critical. A suitable etching action may be obtained using a solution having a causticity equal to that obtained in an alkali metal hydroxide solution in a range of concentration of 5 to 15 per cent. The metal compound may be introduced into the caustic solution by the addition thereto of any suitable soluble salt.

While the compounds of cobalt and copper give good results, it is preferable that copper be present in the etching solution. When a copper salt is introduced into the alkali solution it is generally necessary also that an agent be added capable of holding in solution the copper compound formed. For this purpose I have found ammonium hydroxide to be particularly suitable, but good results have also been obtained by the addition of glycerin, sodium-potassium tartrate, and cane sugar. Similarly, when cobalt salts are added to the alkali etching solution it is generally necessary to add also an agent capable of holding the cobalt compound formed in solution. Sodium-potassium tartrate or cane sugar is preferred for this purpose; glycerin or ammonium hydroxide also work satisfactorily.

The amount of metallic compound to be added varies with the concentration of the alkali solution employed, as well as with the temperature of the etching treatment. The amounts required are quite small, usually of the order of 0.005 to 0.03 per cent of the metal added in the form of the metallic compound. This amount is not critical, however, and can be varied if desired. In commercial practice, when the bath is in continuous use, the metal compound should be replenished from time to time because the metal or some compound of the metal is removed from the bath as a dark deposit or coating which forms on the surface of each article treated. The amount of stabilizing agent added to hold the copper or cobalt compound in solution also varies with the strength of the etching solution and the amount of the metallic compound present.

Usually amounts below about 10 per cent are sufficient, although more may be used if desired.

The time of etching will depend upon the amount of impurities in the surface of the article and the degree of diffusivity desired. An etch of 5 to 10 minutes has generally been found to give good results. The temperature of the bath is preferably maintained at about 140 to 170° F., although higher or lower temperatures may be used if desired. The dark film formed on the aluminum surface during the treatment in the etching solution is removed by treating the article with a solution of strong nitric acid. This treatment dissolves the dark film to expose a uniformly etched bright metallic reflecting surface free from streaks and haze.

As a specific example of the method of my invention a tank was filled with 100 gallons of 5% sodium hydroxide solution, and ½ pound of copper sulfate and 3 pounds of ammonium hydroxide were added. The resulting blue solution was heated to 140° F. and a strip of copper-free aluminum sheet was immersed in the bath for a period of 3 minutes. The sheet so treated was then taken from the bath and treated in a 50% nitric acid bath in which the dark deposit formed in the first step of the process was removed from the surface of the sheet. The sheet was then removed from the acid bath, washed and dried, and exhibited a uniformly etched reflecting surface free from streaks and haze and having a bright metallic lustre.

I claim:

1. A method of etching an article having a copper-free aluminum surface, which comprises treating said surface with a hot etching solution of an alkali having dissolved therein a compound of a metal selected from the group consisting of copper and cobalt.

2. A method of etching an article having a copper-free aluminum surface, which comprises treating said surface with a hot etching solution of sodium hydroxide having dissolved therein a metal selected from the group consisting of copper, and cobalt.

3. A method of etching an article having a copper-free aluminum surface, which comprises treating said surface with a hot etching solution of an alkali having dissolved therein a compound of a metal selected from the group consisting of copper and cobalt until a dark deposit is formed thereon, and thereafter removing the deposit by treating the article with a solvent for said deposit.

4. A method of etching an article having a copper-free aluminum surface, which comprises treating said surface with a hot etching solution of an alkali having dissolved therein a compound of a metal selected from the group consisting of copper and cobalt until a dark deposit is formed thereon, and thereafter removing the deposit by treating the article with nitric acid solution.

5. A method of etching an article having a copper-free aluminum surface, which comprises treating said surface with a hot etching solution of sodium hydroxide having dissolved therein a compound of a metal selected from the group consisting of copper and cobalt until a dark deposit is formed thereon, and thereafter removing the deposit by treating the article with a solvent for said deposit.

6. A method of etching an article having a copper-free aluminum surface, which comprises treating the surface with a hot etching solution of an alkali having dissolved therein a copper compound.

7. A method of etching an article having a copper-free aluminum surface, which comprises treating the surface with a hot etching solution of an alkali containing a copper compound and a reagent capable of maintaining said copper compound in solution.

8. A method of etching an article having a copper-free aluminum surface, which comprises treating the surface with a hot etching solution of an alkali having dissolved therein a cobalt compound.

9. A method of etching an article having a copper-free aluminum surface, which comprises treating the surface with a hot etching solution of an alkali containing a cobalt compound and a reagent capable of maintaining said cobalt compound in solution.

10. A method of etching an article having a copper-free aluminum surface, which comprises treating said surface with a hot etching solution of potassium hydroxide having dissolved therein a compound of a metal selected from the group consisting of copper and cobalt until a dark deposit is formed thereon, and thereafter removing the deposit by treating the article with a solvent for said deposit.

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