

UNITED STATES PATENT OFFICE

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PLATING NICKEL ON ALUMINUM

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2 Claims. (Cl. 204—42)

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This invention relates to the plating of nickel on aluminum.

An object of the invention is to provide a method for plating nickel directly on aluminum after a preliminary treatment. A further object is to provide an improved process by which aluminum is cleaned in ammonium bifluoride, then anodically oxidized in orthophosphoric acid, and then plated directly with nickel in a bath having a suitable pH. Other specific objects and advantages will appear as the specification proceeds.

I have discovered that aluminum and its alloys may be plated with dull or bright nickel as a direct step following a simple pretreatment and without requiring the plating of other metal on the aluminum as a preliminary step to plating with nickel. In my preferred process, the aluminum or its alloy is first cleaned in either a vapor degreaser followed by a mild alkaline dip or an alkaline emulsifying cleaner. I prefer to follow the alkaline cleaner with a dip in ammonium bifluoride-water solution, in which the ammonium bifluoride is from 5% to 20% by weight. This step is followed by an anodic oxidation in orthophosphoric acid in which the piece treated is made the anode in the solution. I prefer to employ commercial orthophosphoric acid, in which the acid is 75% by weight. In the solution, the commercial orthophosphoric acid is preferably from 5% to 20% by volume. A potential of four volts or higher is applied for a short length of time. I find that best results are obtained when the potential is six volts or more. While higher temperatures may be employed, I find that excellent results are obtained at room temperature. Various types of cathodes may be used, but by far the best results are obtained through the use of carbon cathodes.

This treatment produces a very thin adherent coating on the aluminum which serves as a basis for the subsequent plating.

I have discovered that bright or dull nickel can be plated directly upon the above thin conductive coating by carrying on the plating operation in a bath having a pH below six. Any suitable commercial bath may be employed. For example, in plating dull nickel, the solution may contain nickel sulphate of from 25 to 45 ounces per gallon, nickel chloride of from 6 to 9 ounces per

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gallon, and boric acid of from 4 to 6 ounces per gallon. The pH (electrometric) should be from 5.2 to 5.9. The operating temperature may be between 120° F. and 160° F. A satisfactory current density is from 15 to 50 amperes per square foot.

In plating bright nickel, a satisfactory solution may contain nickel sulphate of from 32 to 36 ounces per gallon, nickel chloride of from 5 to 8 ounces per gallon, and boric acid of from 5 to 5.5 ounces per gallon. The usual organic addition agents—brightening and wetting agents—are added. The pH (electrometric) is preferably between 2.5 and 3.5. A current density up to 40 amperes per square foot may be used, and the temperature is preferably in the range of 115° F. to 140° F.

The use of ammonium bifluoride in the pretreating operation followed by the anodic oxidation in orthophosphoric acid gives by far the best results, and the nickel plating is carried on directly upon the thin conductive coating without any intermediate step. The operation is also successfully carried out, but with less satisfactory results by dipping the piece initially in concentrated nitric acid or hydrofluoric acid instead of the ammonium bifluoride solution after the initial vapor degreaser or alkaline cleaner treatment.

While in the foregoing specification, I have set forth certain steps and specific examples as illustrative of one mode of carrying out the invention, it will be understood that such steps and conditions may be varied widely by those skilled in the art without departing from the spirit of my invention.

I claim:

1. In a process for plating nickel upon a metal piece selected from a group consisting of aluminum and aluminum alloys, the steps of dipping said piece in ammonium bifluoride water solution, in which the ammonium bifluoride is from 5 to 20% by weight, anodically oxidizing the piece in an aqueous solution of orthophosphoric acid in which the acid is from 5 to 20% by volume at a potential of at least four volts to form an adherent conductive coating on the piece, and electroplating nickel thereon in a bath having a pH below six.

2. In a process for electroplating nickel upon

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aluminum, the steps of immersing the aluminum piece in an aqueous solution of ammonium bifluoride in which the bifluoride is from 5 to 20% by weight, anodically oxidizing the piece in an aqueous solution of orthophosphoric acid in which the acid is from 5 to 20% by volume under a potential of at least four volts to form thereon a thin conductive coating, and directly electroplating nickel upon said coating in a bath having a pH below six.

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