A process for the plating of a non-metallic material, such as polyethylene or polypropylene strip, which includes the step of immersing said material in an alcohol solution containing boron, phosphorous and a metal selected from the group consisting of gold, palladium, rhodium and platinum. The metal film forms adherently on the strip. The solution is prepared by mixing phosphorous pentoxide in an alcohol solvent. The dissolution of the phosphorous pentoxide is exothermic and the temperature of the solution will rise during the reaction. Then, boric anhydride and a salt of gold, palladium, rhodium or platinum is added. The solution appears to strip any contamination while depositing a layer of the gold, platinum, rhodium or palladium onto the surface of the non-metallic part. The process is particularly advantageous for preparing metallized strips for use during semiconductor device assembly.

3 Claims, No Drawings
PLASTIC PLATING PROCESS AND SOLUTION THEREFOR

RELATED APPLICATION

This invention is related to application Ser. No. 414,587, filed Nov. 9, 1973.

BACKGROUND OF THE INVENTION

This invention relates to the plating of non-metallic parts and, more particularly, to the plating of plastic films such as polyethylene or polypropylene.

To produce a metalized non-metallic member such as a ceramic, it has previously been a practice to at least initiate plating by a vacuum vaporization metallization process. This relatively high temperature process cannot be utilized for plastic materials having lower melting points. In these latter cases, it was necessary to laminate a metal film thereto or coat a strip as by painting. These processes do not produce the adhesiveness of a plating.

SUMMARY OF THE INVENTION

It is an object of this invention to provide an improved process for the cleaning and plating of non-metallic parts or strips.

A further object of the invention is to provide a process for the plating of low temperature plastics, such as polyethylene or polypropylene.

In accordance with these objects, there is provided a process for the stabilization and cleaning of a non-metallic part which comprises the step of immersing said lead frame in an alcohol solution containing boron, phosphorous and a metal elected from the group consisting of gold, palladium, rhodium and platinum.

Further objects and advantages of the invention will be understood from the following complete description thereof.

COMPLETE DESCRIPTION

In accordance with the particular embodiment of the invention, the process is one for removing organic contamination from a non-metallic part prior to plating. During this process, the ever present skin of oxide is also removed. Both the organic contamination and the oxide contamination act to inhibit the adherence and quality of the plating. During the present process, the part is simultaneously plated with an inert noble metal, which prevents regrowth of a new layer of oxide on the part, as would happen if it is subsequently exposed to air prior to plating or metallization.

The process comprises coating a non-metallic material with a complex solution consisting essentially of 1 to 30 grams per liter phosphorous pentoxide, 1 to 60 grams per liter boric anhydride, 0.01 to 10.0 grams per liter of a material selected from the group consisting of gold, platinum, palladium and rhodium salts and oxide, and the balance a solvent selected from the group consisting of methyl, ethyl, propyl, isopropyl, butyl, and isobutyl alcohol, ethylene glycol and tetrahydro furfuryl alcohol.

The process functions by deposition from a selected organic solvent of a thin adherent layer of an inert noble metal, such as gold, palladium, platinum or rhodium, on the aluminum. The noble metal layer may be made mono-atomic in thickness, or, depending on time, films of several microns may be plated, and is stable to ambient conditions of temperature and humidity.

The solution used in the process is a solution of phosphorous pentoxide, boric anhydride and a noble metal salt, such as potassium, gold cyanide, potassium gold chloride, palladium chloride or similar salts of rhodium and platinum. A concentration of dissolved solids of from 0.5 to 4 percent with an atomic ratio of phosphorous-boron-noble metal of 1:3:0.1 has been used. The phosphorous-boron solution serves as the carrier to solubilize the noble metal salt.

A typical solution is prepared by dissolving 1 to 30 grams per liter phosphorous pentoxide in various alcohols, such as isopropyl alcohol. This reaction is exothermic and results in a rise in temperature of the solution. To this solution is added 1 to 60 grams per liter boric anhydride to form a boron/phosphorus ratio in the solution of at least 3:1. This ratio is necessary to prevent hygroscopic side effects after the solution has been dried following treatment in accordance with the process. The foregoing solution forms a stock base solution to which 0.01 to 10 grams per liter noble metal salt will be added prior to use. The noble metal salt should not be added too long ahead of use, since plating of the noble metal on the container will occur spontaneously over a period of a few days. When it is desired to treat the parts in accordance with the subject process, a sufficient amount of the noble metal salt is added to the stock base solution to form a ratio of boron/phosphorous to noble metal of 1:3:0.1. Solution can be generally effected by shaking or stirring in a matter of minutes.

To treat the parts in accordance with the process, a preliminary degreasing in isopropyl alcohol may be utilized, although this is not necessary. The parts are added to the above disclosed solution at room temperature, until an absorption or immersion plating equilibrium is approached. The solution is then decanted from the parts and the parts are rinsed with an alcohol, such as methanol, and air dried. Preferably, the parts are then baked for 30 minutes in air at 200°C. Following this treatment, the parts are ready for further assembly.

EXAMPLE I

A preliminary solution was prepared by dissolving 16 grams of phosphorous pentoxide in 500 milliliters of isopropyl alcohol. To this solution is added 28 grams of boric anhydride, which dissolves in a matter of minutes. The solution is then diluted with another 500 milliliters of isopropyl alcohol, thus forming a stock solution.

To the foregoing diluted stock solution was then added 2.0 grams of palladium chloride. Solution of the palladium chloride was affected over-night. A 1 × 2 × .007 inch test strip of polyethylene when immersed in 250 ml of the above solution in a pyrex beaker at 22°C for 24 hours plated a 5 7 micron film of mirror bright palladium. When scratched and probed with a sharp point, no evidence of delamination was seen at 55X using a microscope.

EXAMPLE II

To 1000 ml of a stock solution prepared as in Example I were added 4 grams of palladium nitrate. Solution was affected overnight A 1 × 2 × .005 inch test strip of polypropylene, when immersed in 250 ml of this solution at room temperature, plated a 5–7 micron film of bright palladium in 10 hours at 22°C that was tightly adhering.
EXAMPLE III

Five hundred ml of the stock solution in Example I were diluted to 1 liter with 500 ml of isopropyl alcohol. Four grams of palladium chloride were dissolved overnight in this solution. A 1 x 2 x .007 inch test strip of polyethylene when immersed in this solution 90 minutes at 65°C plated a mirror bright, tightly adhering film of palladium 5-7 microinches thick.

The foregoing process may be utilized in many ways including, but not limited to, the following:

A. Use in place of evaporation to achieve an electronically "clean" conductive (immersion plated) surface prior perhaps to thicker electro-plating, e.g., the "8 K stack" where 800 A of chromium were evaporated prior to plating a copper layer. This would not require expensive equipment nor clean up time after evaporation on the equipment. No salvage cost and care would be necessary as there is in the bell jars of evaporators.

B. Deposit on alkali-free plate on plastic parts for later electronic use where size, shape, angles, blind holes, etc., preclude the possibility of evaporating such a coating.

C. Place palladium on plastic by this process to provide a clean, alkali-free, conductive surface which also acts as a barrier for diffusion of alkali ions from the plastic which usually contains such ions present as additives (antioxidants, fillers, plasticizers, mold release agents, etc.).

While the invention has been disclosed by way of certain preferred embodiments and examples thereof, it will be appreciated that suitable modifications may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A process of plating non-metallic material which consists of the step of coating the material with a complex solution consisting essentially of 1 to 30 grams per liter phosphorous pentoxide, 1 to 60 grams per liter boric anhydride, 0.01 to 10.0 grams per liter of a material selected from the group consisting of gold, platinum, palladium and rhodium salts and oxide, and the balance a solvent selected from the group consisting of methyl, ethyl, propyl, isopropyl, butyl, and isobutyl alcohol, ethylene glycol, and tetrahydro furfuryl alcohol.

2. In a process as recited in claim 1 wherein said coating step includes immersing a semiconductor device in said complex solution for 1 - 24 hours at room temperature.

3. In a process as recited in claim 1 wherein said coating step includes covering a surface of a semiconductor device with said complex solution for 1 - 24 hours at room temperature.