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PROCESS FOR THE ELECTRODEPOSITION OF ALUMINUM FROM ITS COMPOUNDS

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This invention relates to the electrodeposition of aluminum and relates particularly to a process involving the deposition of aluminum from aluminum compounds dissolved in anhydrous solvents

We have found that aluminum may be plated on a suitable cathode by electrolyzing an ammonium-aluminum compound such as the tetraalkyl ammonium bromide. For example, tetraethyl ammonium bromide is prepared from triethylamine and ethyl bromide by refluxing these reagents in absolute alcohol for a period of about 4 hours and then evaporating the alcohol and any excess of ethyl bromide, under reduced pressure. Thereupon aluminum bromide is added in mol to mol proportions causing liquefaction to set in spontaneously at room temperature with the evolution of heat. This liquid is suitable as an electrolyte for the deposition of aluminum. The procedure of deposit may be carried out by placing in the liquid an anode of aluminum and a cathode of another metal as, for example, copper. The liquid is heated to about 100° C. A cathode current density suitable for the operation is 0.068 amperes per centimeter of cathode surface. The voltage required is 22.6. Operating in this manner an anodic current efficiency of 100 based on the aluminum dissolved has been secured.

An advantage in the employment of an electrolyte of this character is its quality of regeneration. Results obtained in accordance with the foregoing example show that solution of aluminum from the anode is in proportion to the depletion of the solution in aluminum by its deposition on the cathode.

The foregoing is set forth particularly for illustrative purposes, it being understood that the composition of the electrolyte and the precise procedure employed with respect to voltage, current density and other conditions may be varied according to circumstances.

The property which aluminum possesses of resisting ordinary atmospheric corrosion renders the process of prospective value in the coating of metals which normally are readily corroded and which by being plated with aluminum may be expected to acquire new properties of resistance. Furthermore, pure aluminum is very little attacked by certain concentrated acids, such as nitric and acetic. Also, it has been found that sulphur compounds in ordinary petroleum will not corrode aluminum tubes to any appreciable extent, even at high temperatures.

The low tensile strength and especially the low elastic limit of pure aluminum renders it rather unsatisfactory as a structural material for many purposes, even though it is not attacked by corrosive agents of various kinds. Therefore the possibility of electroplating aluminum on steel or other common metals promises a wider range of metallic substances in chemical construction work.

One of the possible uses of aluminum plate is for steel economizer tubes. These tubes contain water inside and hot flue gases on the outside. Flue gases frequently contain a high content of corrosive sulphur compounds due to the sulphur present in the coal employed as a fuel. Among the other applications of the present process we contemplate the electroplating of the outside of such tubes or other tubing employed in analogous operations. Other possible uses to prevent corrosion due to sulphur compounds are lining tubes and reaction chambers used in petroleum cracking stills and for the inside of locomotive smoke stacks.

Still another possibility is that of plating the inside of steel cylinders used to store compressed gases. It is very difficult, if not impossible, to store gas in iron cylinders and have this gas remain in a state of purity, as volatile products are formed by chemical action with the iron. Prevention of such ac-

tion may be expected if the cylinder is lined with a plate of pure aluminum.

Aluminum-plated steel would furnish a material of high tensile strength, great elasticity and notable resistance to corrosion, hence should prove a material which would be useful in many chemical industries. We contemplate, through applying the process of the present invention, to secure various metals protected with a plate of aluminum which will find a wide variety of uses.

The invention is by no means limited to the particular illustration set forth above, but embraces the employment of any metallo-organic compounds or electrolytes constituted in an equivalent or analogous way and having the property of replenishment with aluminum from the anode of that metal during the step of electrodeposition, such replenishment being ample to permit the electrolyte to be used continuously for a considerable period of time for such purpose.

What we claim is:

1. In the art of electroplating a coating of aluminum from solutions of aluminum compounds in organic solvents, the step which comprises conducting the deposition of aluminum in an electrolyte containing tetraethyl ammonium bromide and aluminum bromide with a voltage of 22.6 and a cathode current density of 0.068 amperes per centimeter of cathode surface.

2. An electrolyte for depositing a coating of aluminum on the surface of a dissimilar metal which comprises tetraethyl ammonium bromide and aluminum bromide.

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