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INDIUM PLATING

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The invention relates to the plating of indium and has particular reference to a process and bath for plating indium by electro-deposition.

The primary object of my invention is to provide a new and improved bath and process for the electro-deposition of indium, which has certain advantages over baths and processes heretofore used for this purpose. Other objects and advantages of my invention will become more apparent from the detailed description.

The bath or electrolyte of the present invention is one that has excellent throwing power, is one of good efficiency, and one that is easy to operate and control. The allowable ranges of current densities, voltages, etc., for good deposits are quite broad. The bath is easy to make up in the first place and is free of the danger of HCN fumes, such as might occur in the making up of a cyanide bath unless the operations are performed under a well ventilated hood. The bath or electrolyte of the present invention is one of good conductivity, deposits indium as a fine grained, closely adhering deposit, is easily rinsed from plated parts with water, is non-poisonous, and shows little tendency for the indium compounds to separate after long standing. The indium may be readily recovered from the bath.

The indium plating bath or electrolyte in accordance with the invention may be made by dissolving tartaric acid in water to make a concentrated solution, and adding thereto a compound of indium that is soluble in the tartaric acid solution and allowing it to dissolve therein. The composite solution is then diluted with water and made slightly ammoniacal with ammonium hydroxide. If desired, a material such as ammonium chloride may be added to improve the conductivity of the bath, although such constituent is not essential. I have found that indium which is not normally soluble in a solution which is alkaline with ammonium hydroxide, is however, permanently soluble in such alkaline solution when the tartrate radical is present; also that such ammoniacal tartrate solution of indium comprises an excellent plating solution.

A specific example of procedure in accordance with the invention includes dissolving tartaric acid in water to make a concentrated solution, and adding indium hydroxide to the concentrated solution and allowing it to dissolve therein. The composite solution is then diluted with water and made slightly ammoniacal with ammonium hydroxide. The addition of ammonium hydroxide to the tartaric acid solution of indium compound neutralizes the free acid and at or near the neu-

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tral point indium compound precipitates. Further addition of ammonium hydroxide then brings about solution of the indium compound. The desired point is indicated by the formation of a clear solution. An excess of ammonium hydroxide apparently is not detrimental.

Considerable variation in the make-up of the bath or electrolyte is permissible. A solution containing about ten to twelve ounces of tartaric acid and two to three ounces of indium hydroxide per gallon of water made slightly ammoniacal as described has given very good results. About one ounce of ammonium chloride per gallon of solution may be added, if desired. Other salts may of course be found suitable for improvement of conductivity.

Salts of indium such as indium carbonate, indium chloride, indium sulphate, indium nitrate, or the like, or indium compounds such as indium oxide may be used in place of indium hydroxide in the preparation of the electrolyte.

The bath or electrolyte may be used with considerable variation in the temperature thereof. For convenience, room temperatures of about 70° to 75° F. are generally used. Elevated temperatures volatilize excess ammonia and result finally in precipitation of indium compound. Further addition of ammonium hydroxide will redissolve this precipitate. The current densities and voltages used also may vary considerably. For example, voltages of about three to six may be used with about four being preferred at present when using the specific electrolyte described herein. At lower voltages the covering power is not as good as with the preferred voltage, while at higher voltages the plate is darker colored and not as fine grained. As a specific example, a current density of thirty amperes per square foot of cathode area has been used with success. Insoluble anodes, such as carbon, for example, are used.

By the use of my bath and process indium may be electrodeposited on cathodes of various metals, etc. My bath and process is especially desirable in plating bearings and bearing metals or alloys to render the same corrosion resisting. Cadmium bearings and cadmium alloy bearings, as well as lead and copper-lead bearings, may be readily plated with indium to provide a coating thereon that is resistant to corrosion caused by acid products in lubricants. The plated bearing may be heat treated at about 340° F. to cause the indium to diffuse into or alloy with, the base metal. In making the cadmium or lead bearings a thin layer of cadmium or lead may be electroplated onto a stronger backing mem-

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ber, such as, for example, a steel supporting member.

While I have described a preferred embodiment of my invention, I am aware that many changes may be made and numerous details varied without departing from the principles of my invention and I do not intend to limit the patent granted for my invention except as necessitated by the prior art.

I claim:

1. A process of preparing an electrolyte for the electrodeposition of indium which comprises, dissolving tartaric acid in water to make a concentrated solution, dissolving a compound of indium in said solution, and adding water and ammonium hydroxide to the indium containing solution to make an ammoniacal solution of the desired concentration.

2. A process of preparing an electrolyte for the electrodeposition of indium which comprises, dissolving tartaric acid in water to make a concentrated solution, dissolving indium hydroxide in said solution, and adding water and ammonium hydroxide to said solution to make an ammoniacal solution of the desired concentration.

3. A process as in claim 2, in which the solution contains about ten to twelve ounces of tartaric acid and about two to three ounces of indium hydroxide per gallon.

4. A process for the electrodeposition of indium which comprises dissolving tartaric acid in water to make a concentrated solution, dissolving a compound of indium in said concentrated solution, diluting the resulting solution with water, adding ammonium hydroxide to said

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dilute solution until the same is ammoniacal, and passing electric current through the ammoniacal solution from an anode to a cathode at a voltage of about three to six while said ammoniacal solution is maintained at a temperature of about 70° to 75° F.

5. A process for the electrodeposition of indium which comprises dissolving tartaric acid in water to make a concentrated solution, dissolving indium hydroxide in said concentrated solution, diluting the resulting solution with water, adding ammonium hydroxide to said dilute solution until the same is ammoniacal, and passing electric current through the ammoniacal solution from an anode to a cathode at a voltage of about four and at a current density of about thirty amperes per square foot of cathode area while said ammoniacal solution is maintained at a temperature of about 70° to 75° F.

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