EFFECT OF VARIOUS ELECTROLYTIC CONDITIONS ON Zn-Co-Ti ELECTRODEPOSITION

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Abstract: The electrochemical deposition of alloys with superior properties than pure metals has shown an awakening to the potentials of electrolytic routes to meet the requirements of modern technology in recent years. The deposited alloys can be relatively denser and harder, more corrosion and wear resistant, more protective of basis metals and better in magnetic properties which enable them to find applications in rocketry, computer technology, aerospace industries, etc. Further alloys containing Titanium with Cobalt or Zinc are known to exhibit a high degree of resistivity against destructive environment influences and can fight against corrosion. The electroplating of ternary thin film of various compositions containing zinc and cobalt with a third metal has been extensively studied, but very few attempts have been made to incorporate titanium into such films which could render good mechanical properties to the alloy. In the present study, the possibility of electrodeposition of titanium with zinc and cobalt from a sulphate bath under different electrolytic conditions has been investigated.

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Index Terms **- sulphate bath, electrodeposition, alloy, electroplating.**

I.INTRODUCTION

Electrolytic deposition of thin coatings of alloys with superior properties and better performance are more important than pure metals. Electroplating technique has been used to produce printed circuits, high speed tools, surgical instruments and for the plating of commercially important plastics. The deposited alloys can be relatively denser and harder, more corrosion and wear resistant and protective of basis metals.

Several binary and ternary alloys containing nickel or titanium have been electrodeposited. Ternary alloys of titanium with nickel and/or other metals have become technologically more important because of their potential application as protective coatings against corrosion. In view of these ternary facts, the Cd-Ni-Ti electrochemical deposition of a alloy from sulphate bath was investigated under different electrolytic conditions.In the present study, the possibility of electrodeposition of titanium with zinc and cobalt from a sulphate bath under different electrolytic conditions has been investigated. Attempts were also made to study the effects caused by some additives on the electrodeposition of this alloy. Besides, it was also proposed to study the morphology, micro hardness, and corrosion resistance of these electroplates.

II. EXPERIMENTAL PROCEDURER

The experimental details are given below:

The electrolytic cell similar to that used by Mandelcom et. al. and Schaus assembled from a 0.3 cm thick perspex sheet joined by chloroform was used for electrolysis. Bright stainless steel plates with effective surface area 10 cm2 sealed on glass slide of similar size with Araldite was used as a cathode. Platinum wire sealed in a narrow glass tube was used as an anode. An electrolytic solution containing 16.0 - 22.0 gL-1 zinc sulphate, 9.0 - 12.0 gL-1 cobalt sulphate, 1.5 - 3.0 gL-1 potassium titanium oxalate, 28.0 - 34.0 gL-1 ammonium sulphate, 1.0 gL-1 starch and 1.2 mlL-1 sulphuric acid was electrolyzed under different plating conditions. The electrolytic bath was fairly stable under various electrolytic parameters.

The cathode was weighed before and after the deposition to determine the amount of alloy deposited. A known quantity of alloy was dissolved in sulphuric acid for analysis.Zinc was estimated volumetrically while Cobalt and Titanium contents were determined colorimetrically .

III.RESULT AND DISCUSSION

Thin alloy films having 85.08-99. 03% zinc, 0.91-14.4% cobalt and 0.01-1.41% titanium were deposited at current density 2.0 - 6.0 Adm $^{-2}$, pH 2.30 - 2.45; temperature 25° -40°C. In general uniform, semi bright, blackish grey, thin adherent coatings were obtained at comparatively low pH, current density and moderate temperature. The deposit became partially powdery as the pH or the temperature was increased. Table 1 shows the effect of various factors on electrodeposition.

TABLE 1 Effect of pH and temperature and current density on the deposit composition

pH	Temperature ^{0}C	Metal	Amount (%) of the metal in the deposit at current density (Adm $^{-2}$) of			
			2.0	3.0	4.0	5.0

TABLE 1 Effect of pH and temperature and current density on the deposit composition

2.30	30	Zn	99.03	93.99	92.40	91.66
		Co	0.96	5.65	7.04	7.71
		Ti	0.01	0.36	0.56	0.63
2.35	30	Zn	96.82	93.07	92.20	91.44
		Co	3.02	6.52	7.22	7.90
		Ti	0.16	0.41	0.58	0.66
2.40	30	Zn	96.15	92.47	91.08	90.77
		Co	3.63	7.03	8.30	8.51
		Ti	0.22	0.50	0.62	0.72
2.45	30	Zn	94.43	91.16	89.54	89.00
		Co	5.12	8.10	9.62	10.11
		Ti	0.45	0.74	0.84	0.89
2.35	25	Zn	94.88	92.50	91.83	90.95
		Co	4.77	6.88	7.40	8.21
		Ti	0.35	0.62	0.77	0.84
2.35	35	Zn	97.92	94.85	93.73	92.68
		Co	1.93	4.82	5.75	6.71
		Ti	0.15	0.33	0.52	0.61
2.35	40	Zn	99.01	97.27	94.64	93.04
		Co	0.91	2.52	4.91	6.43
		Ti	0.08	0.21	0.45	0.53

At higher current density the deposits became rough but more smooth and bright grey deposits were obtained with increasing concentration of cobalt in the bath. Deposits became uneven and dark grey with increasing concentration of zinc and titanium.

The percentage of zinc decreased with increase in pH, current density, duration of deposition, whereas titanium and cobalt content increased under similar conditions. Increasing concentration of zinc and titanium ions and decreasing concentration of cobalt ions in the bath increased the zinc content in the alloy while decreased that of the cobalt. Percentage of titanium remained almost unaffected with change in zinc ion concentration but increased appreciably with increasing titanium ion concentration or decreasing cobalt ion concentration in the bath.

The morphological studies of the alloy deposits obtained under various plating parameters showed that grey, uniform, fine grained and compact deposits were obtained at comparatively low pH, high temperature and low current densities.The microhardness of these films increased with decreasing pH, increasing temperature, current density or metal ion concentration in the bath**.**

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