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EFFECTS OF COMPLEXING AGENTS ON ELECTRO DEPOSITION OF TERNARY Zn-Mn-MO ALLOYS

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ABSTRACT

The ternary Zn-Mn-MO alloys were electrodeposited containing Zinc Sulphate 30gL^{-1}, Manganese Sulphate 60gL^{-1}, Ammonium Molybdate 4gL-1, in presence of one of the following complexing agents; Tartaric acid, Sodium tartarate, Ascorbic acid or citric acid. Effect of these complexing agents on deposit composition, Cathode efficiency and morphology of deposits were also studied.

KEYWORDS: Complexing Agents, Composition, Cathode Efficiency, pH, Current Density

INTRODUCTION

In the recent years, electro deposition of alloys has been carried out in non-aqueous solutions [(1)] to avoid electro deposit able hydrogen, but the deposition potentials of the metals are likely to be closer together than that in a aqueous solutions. Thus, the process of electro deposition in aqueous medium has been widely accepted owing to the non toxic, less expensive, nature of the medium. The components of the electrolytic bath have individual roles to play in the deposition of metals whereas the substrate material usually controls its kinetics. There are some important parameters which influence the deposition process e.g. pH of the solution, temperature of the bath, current density, duration of deposition, agitation, presence of complexing agents etc. Generally a plating bath contains conducting salts, buffering agents, complexing agents & metal ions. Among these complexing agents effectively influence on better deposition through optimization of current density, pH and temperature [(2)]. Influence of complexing agents on growth of zinc oxide also reported by Al Inamdar [(3)]. Uses of tartarate ion as weak complexing agent, is also shown by R.W. Peters (4). Electro deposition of Sn-Zn and Sn-Zn-MO layers from citrate bath also rated [(5)]. Thus electro deposition of Zn-Mn-MO was also studied under the influence of various complexing agents.

EXPERIMENTAL PROCEDURE

Thin alloy film were electrodeposited in presence of different complexing agents such as ascorbic acid, sodium tartarate, tartaric acid and citric acid (in amount 5.0gL^{-1}) Different electrolytic conditions and the procedures' adopted for determination of deposit composition have been described elsewhere [(6)]. The electro deposition was carried out by electrolyzing about 225 cm3 of solution consisting Zinc Sulphate 30gL^{-1}, Manganese Sulphate 60gL^{-1} Ammonium Molybdate 4gL^{-1}, Details of electrolytic cell is given anywhere [(7)] Zn-Mn-MO alloy deposited in presence of citric acid, Tartaric acid, ascorbic acid, sodium tartarate, and their effects on deposit composition, Cathode current efficiency for deposition of Molybdenum, Manganese and Zinc at a pH of 2.05 at 25^{o} C and various current densities (table 1) were studied. Zinc, Manganese and Molybdenum concentration in the deposit, In presence of various complexants at 25^{o}C, at pH of 2.05 and various current densities are given in Table 2.

RESULTS AND DISCUSSIONS

Various complexing anions and ligands are reported generally to shift the equilibrium potentials to more negative values, sufficient to lead to the co deposition of metals over potential is generally larger in such media and results in much finer grain size of the deposit by suppressing the tendency of treeing or form dendrites. The shift will be greater the concentration of the complexing species. The nature of the electrolyte, specially an anion has a considerable effect on the properties and adherence of the electrodeposits. The difference in the behaviour of difference electrolytes is sometimes due to the possibility of the formation of the colloidal matter which serves to give fine grained deposits.

Hence, electro deposition of this alloy was also carried out in presence of different complexing agents viz. ascorbic acid, sodium tartarate, tartaric acid and citric acid (in amount 5.0 gL^{-1} and their effects on deposit composition, cathode current efficiency and distribution of total current utilized for the deposition of molybdenum and densities (Table 1). It was observed that both molybdenum and manganese percentages in the deposit increased with increasing current density. Zinc, by contrast, decreased in presence of all complexing agents. The variation of deposit composition (see table 2) with various complexants in the bath could be attributed to the difference in the stability of the complexes and also to the some extent to the change in the mobility's of metal ions. At any current density used in these investigations the total current efficiency in presence of the above complexing agents was found to be in the following order as in evident from Table.

Tartaric Acid>Sodium Tartarate>Ascorbic Acid>Citric Acid

A maximum value of 74.756% was observed with tartaric acid in the bath at a current density of 2.0 Adm^{-2}. The difference in the extent of formation of complex ions might b the cause of this variation in the efficiency.

CONCLUSIONS

In presence of ascorbic acid, sodium tartarate and tartaric acid the deposits were dark grey, rough, uneven, and less adherent but citric acid was used as a complexing agent the deposits were bright, grey, smooth, even and adherent. Therefore, citric acid was chosen as complexing agent.

REFERENCES

1. W. Simca, Electrochimica Acta, Vol. 54 (23), 2009 pp 5307-5319.
2. Scientific Research & Essays Vol.6 (20), 2011 pp4264~4272.
3. A.L. Inamdar, Int. J. Electro Chem. Sci, 2, 2007 pp 797~798.
4. R.W. Peters particulate Science & Technology Vol. 6 (4) 1988.
5. H. Kazimerczak Surf. Science 2012.
6. Renu Rastogi Ind. Journal of Chemical Technology, Vol. 17 2010 pp 381~385.
7. Renu Rastogi Journal of Chemistry in Asia Vol. 3, 2012 pp 79~85.

APPENDICES

Table 1: Effect of Complexing Agents on Deposit Composition, Cathode Current Efficiency at 25° C, a pH of 2.05 and at Different Current Densities

Complexing Agents 5.0 (gL^{-1})	Current Density (Adm^{-2})	Metal in Deposit (%)			Cathode Current Efficiency (%)
		MO	Mn	Zn	
Ascorbic Acid	2.0	1.52	3.80	94.68	46.66
	3.0	1.76	6.00	92.24	47.32
	4.0	1.96	7.00	91.04	48.76
	5.0	2.16	8.80	89.04	48.96
	6.0	2.20	9.40	88.40	49.88
Sodium Tartarate	2.0	1.04	1.32	97.64	61.02
	3.0	1.88	3.56	94.56	56.60
	4.0	2.20	4.40	93.40	55.46
	5.0	2.68	4.80	92.52	54.73
	6.0	3.24	6.60	91.16	53.24
Tartaric Acid	2.0	0.64	1.84	97.52	74.76
	3.0	1.64	4.88	93.48	73.72
	4.0	1.88	5.20	92.92	68.01
	5.0	2.20	7.00	98.80	60.13
	6.0	2.68	9.20	88.12	59.40
Citric Acid	2.0	0.20	0.10	99.70	42.10
	3.0	0.24	0.12	99.64	41.36
	4.0	0.30	0.40	99.30	41.10
	5.0	0.48	1.06	98.46	38.07
	6.0	0.60	1.18	98.22	37.62

Bath Composition (gL^{-1}): Zinc Sulphate 30.0, Manganese Sulphate 60.0, Ammonium Molybdate 4.0, Starch 1.0

Table 2: Variation in Cathode Current Efficiency with Different Complex Agents at 25°C, a pH of 2.05 and at Different Current Densities

Current Density (Adm^{-2})	Cathode Current Efficiency (%)			
	Ascorbic Acid 5.0 (gL^{-1})	Sodium Tartarate 5.0 (gL-1)	Tartaric Acid 5.0 (gL-1)	Citric Acid 5.0 (gL-1)
2.0	46.66	61.02	74.76	42.10
3.0	47.32	56.59	73.72	41.36
4.0	48.76	55.46	68.01	41.10
5.0	48.97	54.73	60.13	38.07
6.0	49.88	53.24	59.40	37.62

Bath Composition (gL^{-1}): Zinc Sulphate 30.0, Manganese Sulphate 60.0, Ammonium Molybdate 4.0, Starch 1.0