

# EFFECT OF DIFFERENT ELECTROLYTIC CONDITIONS ON Cd-Ni-Ti ALLOY PLATING

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**Abstract :** Ternary deposits containing titanium are electrodeposited mainly from acidic bath. Recently the use of sulphate bath has become widely accepted for the electrodeposition of these films. Purpose of the present paper to study the morphology, microhardness and the corrosion resistance of these electroplates. This paper presents the deposit titanium with nickel and cadmium to give alloys having corrosion resistant and possess better mechanical properties.

**Index Terms - cathode potential, ternary alloy, electrodeposition.**

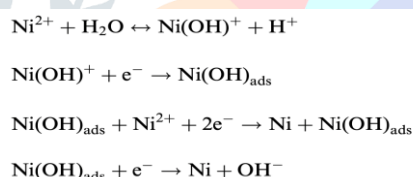
## I. INTRODUCTION

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.

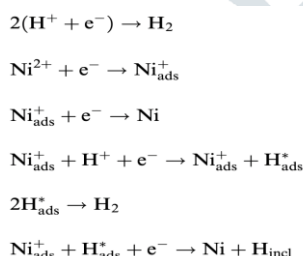
Several binary and ternary alloys containing nickel or titanium have been electrodeposited. Ternary alloys of titanium with nickel and/or other metals have become technologically more important because of their potential application as protective coatings against corrosion. In view of these ternary facts, the Cd-Ni-Ti electrochemical deposition of a alloy from sulphate bath was investigated under different electrolytic conditions.

## II. PRINCIPAL

A survey of the reaction mechanism, as well as the kinetics of nickel electrodeposition from different baths, was given by Saraby-Reintjes and Fleischmann. The generally accepted mechanism involves two consecutive one-electron charge transfers, and the participation of an anion with the formation of an adsorbed complex. This mechanism can be represented as:



where Ni(OH)<sub>ads</sub> represents the active intermediate, which may also be a chloride containing complex. The following mechanisms were suggested for electrolytes of pH 2–4 for Ni metal but all other metal deposition simultaneously at cathode.



## III. Experiment

The deposited titanium with nickel and cadmium to give alloys which may be more corrosion resistant and possess better mechanical properties. In view of these ternary facts, the Cd-Ni-Ti electrochemical deposition of a alloy from sulphate bath was investigated under different electrolytic conditions. the morphology, micro hardness and the corrosion resistance of these electroplates. Attempts were also made to study the effects of a few addition agents such as dextrin, glycine, sucrose, sulphosalicylic acid and thiourea on the electrodeposition of this alloy. The experimental details and the results obtained are briefly summarized as given below :

### i. Material Required

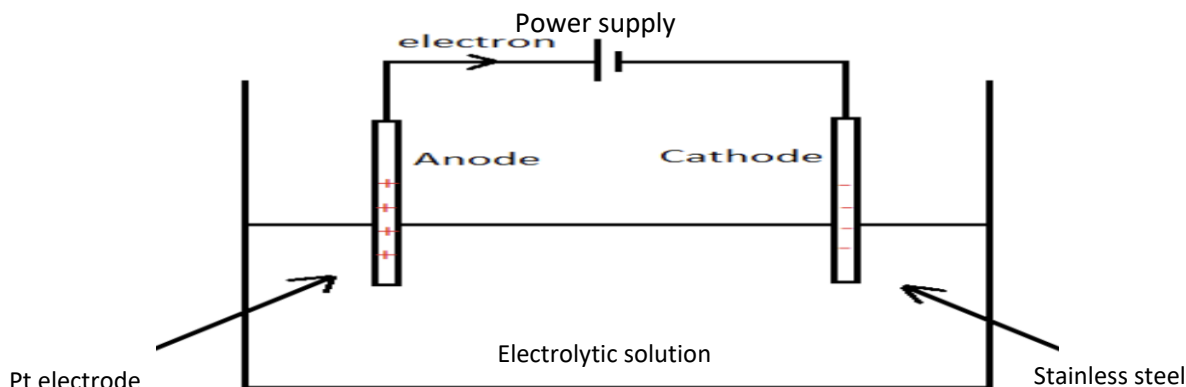
An electrolytic solution containing 55.0-70.0 gL<sup>-1</sup> nickel sulphate, 1.5-3.0 gL<sup>-1</sup> potassium titanium oxalate, 10.0-17.5 gL<sup>-1</sup> cadmium sulphate, 15.0- 30.0 gL<sup>-1</sup> ammonium sulphate, 1.0 gL<sup>-1</sup> starch and ~ 2 mL<sup>-1</sup> sulphuric acid was electrolysed for 30 min under various electrolytic conditions.

## ii.Experimental Procedure

The electrodeposition is carried out in a rectangular cell electrolyte cell. It was assembled from a 0.3 cm perspex sheet (15.5 x 3.5 x 10 cm ) joined by chloroform. A platinum wire sealed in a narrow glass tube was used as an anode. Bright stainless steel plate (5 x 2 cm ) pasted on a rectangular glass slide of similar size with Araldite. Was used as a cathode. Its edges were also covered by it to avoid the uncertainties of their surface area. An effective surface area of 10 cm<sup>2</sup> was thus obtained and in this way a uniform

**Figure 1. The electrolytic cell**

current density was maintained.



## IV. OBSERVATION

Thin Cd-Ni-Ti alloy films containing 0.81-14.65% nickel 0.10-0.68% titanium and 84.81-98.92% cadmium were obtained at current density 1.0-4.0 Adm<sup>-2</sup>; pH 1.8-2.1; temperature 20-35 °C. In general uniform, semibright, light grey, adherent, thin coatings were obtained at comparatively low values of current density and temperature. Their brightness was increased with increasing pH and current density and was decreased with increasing temperature of the electrolytic bath. Increasing concentration of nickel or cadmium in the electrolyte favoured more smooth, even and light deposits, whereas uneven and dark grey deposits were obtained with increasing titanium concentration.

## V. RESULT AND DISCUSSION

The nickel and titanium percentage in the deposits were increased with increasing current density, concentration of titanium ions in the electrolytic bath and duration of deposition, while that of cadmium was decreased under similar conditions. The amount of nickel in the alloy was raised with increasing pH, temperature, and concentration of nickel ions in the bath, whereas that of cadmium and titanium exhibited the reverse behaviour. Further, the concentration of cadmium in the deposit was increased as the amount of cadmium in the bath was increased, while that of nickel and titanium showed a downward trend. The deposit composition was also changed by varying the concentration of complexant in the bath.

Table 1. Shows the effect of pH and temperature and current density on the deposit composition. The variation of alloy composition and cathode current efficiency with the plating parameters have been explained on the basis of theory of deposition and by analysing the distribution of total current utilized for the discharge of nickel, titanium, cadmium and hydrogen ions as a function of current density, pH, temperature, concentration of the various metal ions, complexants and duration of electrolysis.

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

pH	Temperature °C	Metal	Amount (%) of the metal in the deposit at current density (Adm <sup>-2</sup> ) of			
			1.0	2.0	3.0	4.0
2.0	20	Ni	1.22	2.89	3.26	5.71
		Ti	0.27	0.41	0.55	0.63
		Cd	98.51	96.70	96.19	93.66
2.0	25	Ni	1.85	3.25	4.12	6.98
		Ti	0.23	0.40	0.53	0.62

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

		Cd	97.92	96.35	95.35	92.40
2.0	30	Ni	2.61	3.66	4.88	9.36
		Ti	0.23	0.37	0.49	0.59
		Cd	97.16	95.97	94.63	90.05
2.0	35	Ni	2.85	4.09	5.19	10.54
		Ti	0.21	0.35	0.40	0.49
		Cd	96.94	95.56	94.41	88.97
1.8	30	Ni	0.81	1.22	3.25	5.69
		Ti	0.27	0.49	0.61	0.68
		Cd	98.92	98.29	96.14	93.63
1.9	30	Ni	1.19	1.63	3.66	6.92
		Ti	0.23	0.39	0.54	0.61
		Cd	98.58	97.98	95.80	92.47
2.1	30	Ni	3.15	4.02	6.51	14.65
		Ti	0.15	0.22	0.35	0.54
		Cd	96.70	95.76	93.14	84.81

## VI CONCLUSION

Hence we see that the technique of electrodeposition has been gaining importance in recent years because of their greater practical utility in modern technology for special items which cannot be produced in another way. The coating of alloy is used in manufacturing in different items the other major application of it is in the protection of iron and steel from pollution and such as sculpture, bells and for musical instrument copper and Nickel mainly used.

## VII REFERENCES

- (1) Shukla S.D. & Srivastava N., J. Biol. chem Res. Vol 12, No 1 & 2, pp 130-134 (1993).
- (2) Shukla S.D. & Srivastava N., Ind. J. Chem. Tech. Vol 12, Nov 1994, pp 133-136 (1994).
- (3) A Srivastava S, Srivastava N & Agarwal YK, Ind. Journal of Chemical Technology, 7(Nov 2000) pp 267-272.
- (4) Brenner A, Electrodeposition of Alloys: Principles and Practice, Vol 1 (Academic Press, New York) 1963.
- (5) Raub E, Z Electrochem. 55(1951) 146.
- (6) Ichioka S, Jpn Patent 75, 06, 416 (Ci. C 25 D, C 22 CH01F) 1975.
- (7) Shklovskaya NI, Murashova IB, Bondarenko OF & Morochkin VI, Probl. Elektrokhim Korroz Met., 1 (1977)
- (8) Seiter A, Fischer H & Albert L, Electrochim Acta 2 (1960) 97.
- (9) Turner DR & Johnson GR, J. Electrochem Soc, 109 (1962) 778.
- (10) Danjanovic A, Shetty THV & Bockris J 'OM, J Electro Soc, 113(1966) 429.
- (11) Nippe MW & Fischer H, Electrochim Acta 12 (1967) 369.
- (12) Shukla RK, Jha SK & Srivastava SC, J Appl Electrochem 11 (1981) 697.
- (13) Vogel AI, A textbook of quantitative Inorganic analysis, 3rd ed. (ELBS and Longmans Green and Co. Ltd. London), 1961.
- (14) Lowenheim FA, ed. Modern Electroplating, 2nd ed (Wiley, New York), 1963, 470.
- (15) Gardam GE, Trans Faraday Soc. 3(1938) 698.
- (16) Antropov LI, Theoretical Electrochemistry, Mir. Pub. Moscow (1972) 496.