Tin-Cobalt Alloy Plating from the Pyrophosphate Bath

By (Miss) VASANTA SREE & T. L. RAMA CHAR

Dept. of Inorganic and Physical Chemistry, Indian Institute of Science, Bangalore-12.

THE plating of tin from the pyrophosphate bath has been studied in this laboratory[1]. Tin-cobalt alloys have not been deposited from the pyrophosphate bath, and there is a mention of the use of chloride-fluoride solutions[2].

The bath for alloy plating consisted of stannous pyrophosphate, cobalt chloride and potassium pyrophosphate. It was possible to obtain good quality deposits, white to dark grey in colour, in the composition range 13-100% tin under the following conditions: bath composition-tin 0.025—0.1M, cobalt 0.025—0.3M, pyrophosphate 0.31—0.78M (molar ratio of pyrophosphate to metal 2.5), pH 8.5—10.7, temp. 40—80°C, bath voltage 1.9—3.9v, platinum electrodes, agitation 800 r.p.m., cathode c.d (max) 9.8 amp/dm², cathode efficiency 35—100%. Table I gives some typical results to show the effect of variables on alloy plating.

The tin content in the alloy increased and the cathode potential decreased with increase in the tin content of the solution, decrease in c.d. and increase of temperature or agitation. Variation in the pH and pyrophosphate content had little effect. The following addition agents were tried: ammonium citrate, ammonium citrate plus nickel chloride, gelatin, dextrin, boric acid, ammonium bifluoride, hydroquinone plus sodium sulfite. Ammonium citrate gave better quality deposits, and with nickel chloride in addition it was possible to obtain a ternary alloy containing 42-90% tin and 40-7% nickel, balance being cobalt. All

TABLE I

Temp. 60°C, pH 9.5-9.9. *40°C, **80°C, ***addition am. citrate 10 g/l. For each concentration the first figure under c.d gives Sn% by weight in the deposit, the second the cathode efficiency % and the third the cathode potential (-ve sign) in volts on hydrogen scale.

Conc. in soln., M		c.d., amp/dm²							
Sn	Co	0.7	2.1	2.8	4.2	5.6	7.0	8.4	9.8
0.05	0.1	98	96	87	68	54	45		
		99	98	83	69	56	43		
		0.92	1.20	1.29	1.36	1.39	—		
0.05	0.2	96	91	74	58	48		37	
		100	93	70	70	74		64	
		0.91	1.13	1.25	1.33	1.37		1 52	
0.05	0.3	95	63	60	58	38		28	
		100	72	67	65	61		35	
		0.82	1.10	1.21	1.25	1.36		1.44	
0.05	0.2	*94	80	63	44				
		100	55	52	64				
		1.15	1.34	1.42	1.51				
		**98	95	90	83	71		53	42
		100	100	100	93	87		77	72
		0.83	1.00	1.05	1.19	1.28		1.37	1.42
		***98	94	88	74	55			55
		96	95	81	70	74			49
		0.93	1.24	1.30	1.35	1.41			1.57

of them increased the tin content of the deposit. In most cases a low tin alloy could be obtained at a a c.d. of 2.1 amp/dm^2 and above. The high cobalt alloys were bright, but the cathode efficiency was rather low.

Further work, including studies on structure of the deposits, is in progress.

REFERENCES

1. J. Vaid and T. L. Rama Char, J. Electrochem. Soc., **104,** 282 (1957).
2. F. A. Lowenheim and R. T. Gore, Iron Age, **179,** No. 17, 112 (1957).