Bright Tin-Bismuth Sulfate Baths

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A number of modifications of sulfate–type tin-bismuth plating baths were tested with respect to bath throwing power, composition and properties of the deposits. A proper combination of organic additives allows to produce uniform bright coatings with bismuth content about 0.5%. Small concentrations of chloride ions were found to improve bath characteristics, while higher concentrations reduced bath throwing power.

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Introduction

Tin-bismuth coatings are used in electronic industry, in the production of PCBs, etc.

Sulfate baths have a number of advantages: good throwing, high conductivity, stable quality of deposits, which usually contain 0.6 - 1.7 % of bismuth.

Composition of sulfate-based tin-bismuth plating solutions which are used in many shops in Russia are given in Table 1.

Bath Composition and Operating Conditions

Table 1. Composition of tin-bismuth baths.

Components	Bath # 1	Bath # 2
$SnSO_4$, g/l	50	50
$Bi_2(SO_4).3H_2O$, g/l	1	1
H_2SO_4, g/l	120	120
Antioxidant, g/l	2	2
Etoxylated fatty alcohol, g/l	20	20
Benzylidene acetone (alcoholic solution), ml/l	8	8
Formaldehyde, ml/l	-	4

Dull or semibright coatings are formed in the solution #1, and bright ones – in the solution # 2 which containes formaldehyde in addition to other organic components.

The composition of the coatings, current efficiency and data on deposits appearance for the bath # 1 are given in the Table 2.

Tabl.2. Composition, current efficiency and appearance of tin-bismuth deposits obtained in the bath # 1.

Current density, A/dm^2	Bismuth content, % (wt)	Current Efficiency, %	Deposits appearance
1.0	0.6	100	Dark dull
2.0	0.7	92	Dark with light stpipes
3.0	1.0	89	semibright
4.0	1.5	79	semibright
5.0	1.7	67	semibright
6.0	1.5	42	Semibright with pitting

Addition of formaldehyde results in higher current efficiency and improved appearance of deposits – bright deposits are obtained over the whole range of operating current densities, i.e. from 2 to 5 A/dm^2 (Table 3).

Table 3. Current efficiency in the Bath #2.

Current density, A/dm^2	1	2	3	4	5
Current Efficiency, %	100	100	97.6	91.5	98

Throwing power of both baths is in the range of 40 to 50 %, although formaldehyde acts as a depolarizing agent (Fig.1).

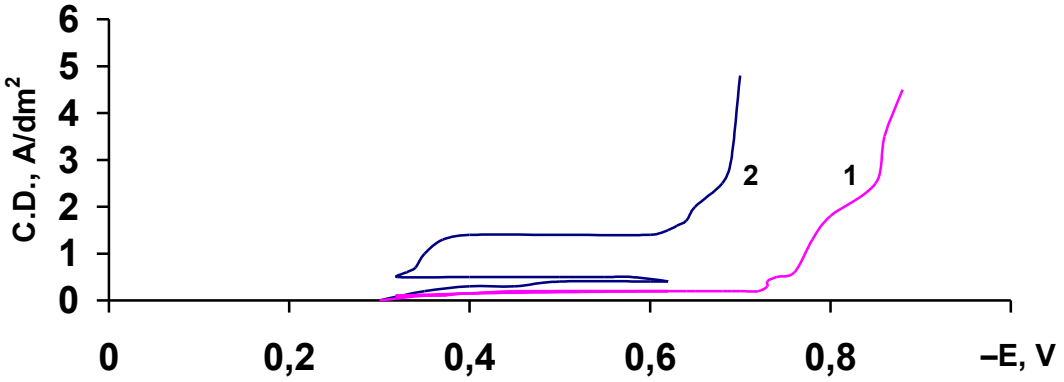

Fig.1. Galvanodynamic polarization curves for the bath # 1 (1) and bath # 2 (2).

In order to facilitate the codeposition of bismuth with tin addition of small amounts of chlorides have been also tested (NaCl 0.1 to 1 g/l). However bismuth content ≥0.6 % is quite sufficient and is achieved even in the absence of chlorides (Table 2). Small amounts of chlorides (0.1 – 0.2 g/l NaCl) slightly improve the appearance of the deposits obtained in the bath # 1. Addition of chloride ions to the bath # 2 produces no visible effect at NaCl concentrations of 0.1 - 0.2 g/l. At higher concentrations (0.5 – 1.0 g/l) brightness is worsened especially at lower current densities.

Conclusions

1. Sulfate tin-bismuth baths with a combination of organic additives allow to produce semibright or bright coatings with bismuth content 0.6 to 1.7 %.
2. Baths have wide current density range and good throwing power.
3. There is no need to add chloride ions to facilitate composition of bismuth.