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USING NONSTATIONARY ELECTROLYSIS FOR FORMATION SN-BI COATINGS

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The use of periodic pulse reverse current allows to form tin-bismuth electroplated coatings, with high value of term storage stable solderability. The reseach results of the influence of nonstationary electrolysis on solderability of the Sn-Bi alloy coatings have been demonstrated. The appropriate conditions for obtaining high-quality lead-free coatings with high solderability have been found. The best mode is $i^k_{av} = 1.0\ A/dm^2$, τ_{forw}: $\tau_{rever} = 4:1$, *f= 0.1…1 Hz.*

Among the special electrochemical coatings with high quality and reliability of solder joints in electronic equipment, Sn-coatings are especially pointed out. However, pure Sn tends to spontaneously phase transformation at low temperatures and during prolonged operation. Numerous bath compositions for formation of Sn-based alloys are developed in order to eliminate this phenomenon. Zinc, nickel, antimony, silver, copper, and bismuth are used as alloying components in those baths.

Most economical and promising for conditions of mass production of microelectronics are Sn-Bi, Sn-Sb, Ag-Sn alloys [1].

However, existing processes for the formation of deposited by DC Sn-based coatings are inefficient (0,1-0,12 m / h), and don't provide the desired solderability that decreases after three months of storage as a result of high value of porosity and low texturing of the coating.

One way of solving this problem is the use of nonstationary electrolysis. As electrocrystallization current is one of the main factors determining the electrochemical and structural conditions for the cementation, so it can widely control quality of the coatings by changing current according to certain laws.

Using periodic pulse reverse (PPR) current electroplating leads to changing of ordinary way of crystals formation, their growth and properties of coating.

PPR current is sequentially alternating cathodic and anodic processes on one electrode. Periodic dissolving the most active portions of the cathode (usually protrusions) tends to equalize the surface, makes it more uniform. In this case, number of lattice defects, porosity, and content of impurities in the precipitate are reduced [2].

Based on the above mentioned using nonstationary electrolysis for deposition Sn-Bi-coating is current and advanced affairs.

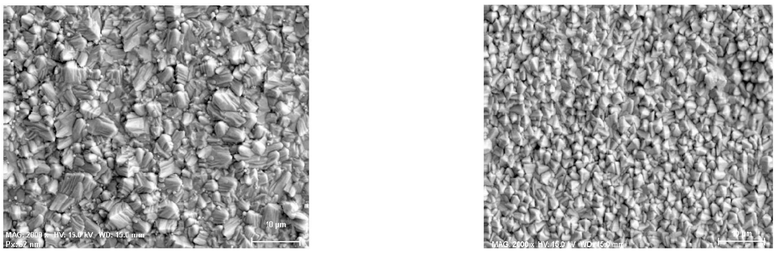
The influence of nonstationary electrolysis was tested on the Sn-Bi-coating. Plating solution contained $SnSO_4$ (50 g/l), $Bi(NO_3)_3$ (1.4 g/l), H_2SO_4 (125 g/l), neonol AF-9-10 (4 g/l), additive CCN-32 (2g/l), which was manufactured by research and production association «SEM.M». Coatings were plated at room temperature.

Electrodeposition was performed by using developed BSUIR power supply SP 24-5. Power supply can form pulses of positive and negative polarity, whose parameters are set by the computer.

According to GOST 9.302-88 the functional properties of coatings were investigated.

Varying the parameters of PPR current leads to the formation of dense, uniform, fine-grained coatings (Fig. 1) and allows expanding the range of operating current densities.

It has been established that the value of the solder spreading factor is reduced from the value from 96% to 87% on a constant current (on the current density from 0.5 to 2 A/dm^2). Solder spreading factor is index of solder wettability of the coatings. Also, this DC technology does not provide long-term storage of solderability due to its high porosity and a coarse crystalline structure.



a b

Fig. 1 The influence of DC (a) and PRC (b) (i_k^{av}=0.5 A/dm^2, γ=1,67, f=0,1 Hz) on the structure of Sn-Bi coating

Reduction of solder spread factor with increasing current density occurs due to the quality degeneration of the coating under higher densities. The quality degeneration of surface is observed by using DC (i_k =1.8 A/dm^2). Using nonstationary electrolysis extends range of operating current densities and allows to increase limit of operating current and to form light metal coatings with high value of the solder spreading factor. Reseach of solderability after three months in laboratory condition was conducted. It has shown that using nonstationary electrolysis leads to forming of coatings with high value of term storage stable solderability (tables 1…3).

Table 1 – Solderability of Sn-Bi pulse electrodeposited alloy (i_k^{av} = 0,5 A/dm^2, f = 10 Hz)

f, Hz	Solder spreading factor, %		Relative variation, %
	as-plated coatings	stored	
1,25	91,8	77,3	15,8
2	91,5	81,9	10,5
2,5	90,9	86,2	5,2
3,33	89,0	82,6	7,2
5	91,3	84,8	7,1

Table 2 – Solderability of Sn-Bi PPR electrodeposited alloy (i_k^{av} = 0,5 A/dm^2, γ = 1,67)

f, Hz	Solder spreading factor, %	
	as-plated coatings	stored
0,1	89	76
1	91	78
10	90	83
100	84	70
1000	90	83

Table 3 – Solderability of Sn-Bi PPR electrodeposited alloy with different ratios of length of the forward and reverse pulse (i_k^{av} = 1,0 A/dm^2, f = 1 Hz)

τ_{forw}: τ_{rever}	Solder spreading factor, %	
	as-plated coatings	stored
3:1	94	88
4:1	93	88
10:1	83	80
20:1	92	89

It's been established, that using PPR current allows to form Sn-Bi coatings with high value of solderability continuing long-term storage.

Optimal conditions for obtaining high-quality lead-free coatings with high solderability were developed. The best PPR mode was selected: i^{k}_{cp} = 1,0 A/dm^2, τ_{forw}: τ_{rev} = 4:1, f= 0,1..1 Hz.

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MODERN TECHNOLOGIES IN TASKS OF WEATHER FORECASTING

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This article deals with modern technologies of processing of weather information. The model WRF (Weather Research and Forecasting) of weather forecasting is described in it.

In the atmosphere there are the diverse physical processes which are continuously changing its state. The physical condition of the atmosphere near the earth's surface and in the lower 30 – 40 km is called weather. Data for a weather forecast are gathered from various sources: meteorological stations, meteorological balloons, space satellites, etc. World centers of a weather forecast receive information from all over the world and compose global weather forecasts (fig. 1).

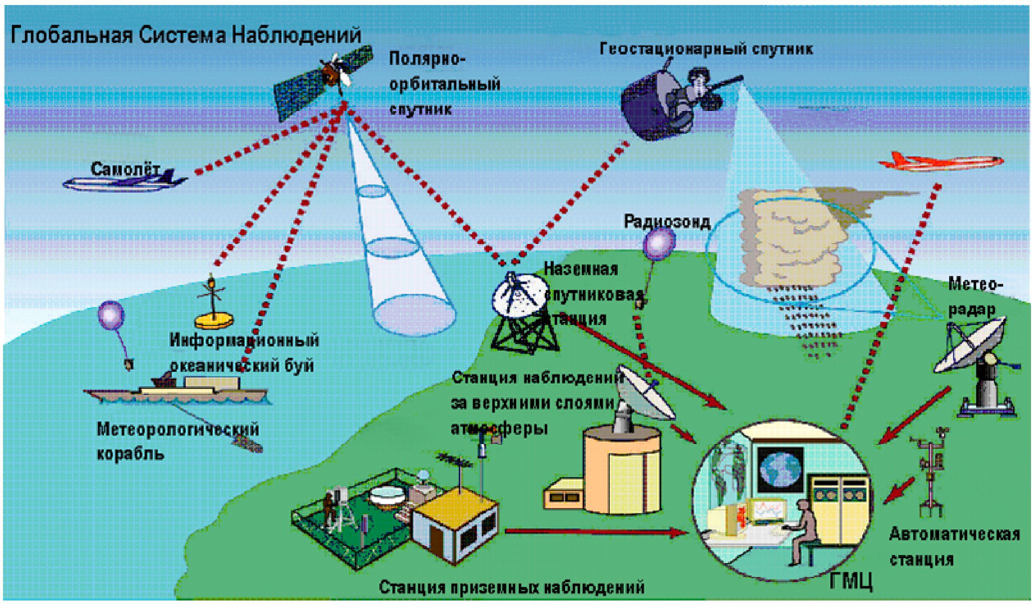

Fig. 1. Composition of global weather forecast

Weather forecasting are used synoptic, statistical and numerical methods. Synoptic method of forecasting is based on the analysis of weather charts. Statistical forecasting methods allow the past and present state of the atmosphere to predict the future state of the weather, i.e. predict changes in various meteorological parameters in the future. Numerical weather prediction (NWP) became a significant source for weather forecasts. NWP model is a modern set of computer programs that contains mathematical and physical equations / algorithms to describe