

## ABSTRACT

«Galvanic coatings in instrument making. Development of the technology of tin deposition on the studio design of printed circuit boards »

Berehova N. Kyiv:NTUU «IgorSikorskyKPI», CTF, EC-51

Diploma project, 2019. Number of pages – 96, tables– 27 , pictures – 7, literature –18 .

The printed circuit boards are intended for installation of electric radio elements, and also for switching of separate units of devices with each other. They are widely used for the manufacture of various electronic equipment, radar equipment, airborne equipment of aircraft, missiles, spacecraft, etc. Recently, printed circuit boards are used for the manufacture of computer technology.

In order for the characteristics to meet the current requirements for printed circuit boards, they must have:

- High accuracy of location of conductive drawing;
- Large magnitude of the resistance of the dielectric;
- High mechanical strength;
- Good soldering ability, especially after long-term storage

A two-way hard board was chosen because it would be fitted with elements of the electronic computing system with the ability to connect the system elements on both sides, as well as in the modern instrumentation, one-sided boards are almost not used.

The details to be processed are printed circuit boards that have undergone a drawing operation, retouching and adjustments. The pattern of the scheme serves as a brilliant copper coating, the free parts of the blanks are covered with a protective film photoresist. The area of the workpiece is  $220 \times 225$  mm.

The variety of areas of use of printed circuit boards, objects of their installation, operating conditions, elemental basis, electrical requirements, reliability, cost requires a large variety of PCB designs, and since each method of manufacturing printed circuit boards has certain technological capabilities and allows you to obtain a drawing of printed elements (conductors, contact pads, etc.) of a certain size and accuracy, that is, a certain class of accuracy of printed circuit boards.

A composite call method was chosen for the graduation project, as it involves the operation of applying tin coating on the conductive layer of printed assembly cards.

Tin is the most promising metal resin in the manufacture of printed circuit boards.

Tin is a silvery-white metal with several modifications. The tin density is  $7.28 \text{ g / cm}^3$ , and the melting point is  $232^\circ \text{ C}$ . It has a high chemical resistance, oxidizes under the influence of moist air, almost does not react with dilute solutions of  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$  and  $\text{HNO}_3$ , is not soluble in concentrated  $\text{HNO}_3$ . Concentrated solutions of alkalis during heating dissolve tin with the formation of stannates.

Tin corrosion products are almost not harmful to humans, so it is used to protect cans and other products related to the storage, preparation and transportation of food products.

Tin coatings are very plastic and can withstand rolling, stamping and stretching.

The tin deposition as a galvanic coating is carried out after the main galvanic copper, in order to protect the conductive pattern during the copying of copper from PCBs. The process is carried out in a single technological cycle with basic copper.

Based on the technology of manufacturing printed circuit boards at the State Enterprise "Galvanotekhnika", PJSC "Kyiv Plant" Radar ", the thickness of

precipitation of galvanic tin was chosen. According to the technology of this plant, tin as a metal resin is galvanically applied in a thickness of 8 microns.

The workpieces of printed circuit boards, which have undergone the operation of applying a film photoresist on the supports, fall into further processing - preparatory and intermediate operations are carried out, namely cleaning of the surface of the conductive drawing from fatty contaminants, removal of surface oxides, washing.

The grinding electrolytes used in the production of printed circuit boards must meet these requirements [10]:

- have a high dispersion ability and uniform deposition of the layer of tin on the leading figure;
- to provide a uniform fine crystalline coating;
- have a high rate of tin deposition;
- be inert with respect to the material of the base;
- their use is economically profitable.

Salt and alkaline electrolytes are currently used in industry for the deposition of tin. Acid electrolytes can be prepared on the basis of one of the acids: sulfate, chloride, boronfluoride, silicon fluoride, phenolsulfonic and the corresponding salt of tin. Polarization in the allocation of tin from acidic electrolytes is small, therefore, in the absence of surfactants (surfactants) precipitated only rough, rough and spongy coatings. Improvement of the structure of sediments is achieved by the introduction of the drug OS-20, mesentery glue, DN-20 syntanol, formalin, cresol, naphthol, gelatin, etc.

In the elaborated project it is proposed to use electroplating of the following composition in galvanic tinplate of printed assembly: g / l:

Components of the electrolyte	g / l
SnSO <sub>4</sub>	50

H <sub>2</sub> SO <sub>4</sub>	60
Na <sub>2</sub> SO <sub>4</sub>	40
Preparation of OS-20	3

Electrolysis mode:

- Temperature 18-25 ° C
- Current density 1- 2 A / dm<sup>2</sup>
- Duration 8 minutes

The advantages of the selected electrolyte are in high electrical conductivity and scattering ability. Also, its components are available, the electrolyte is readily prepared. Due to the surfactant, uniform crystalline precipitates are formed as a result of electrolysis.

In accordance with the technological process of applying tin coating on printed circuit board, which acts as a metal resin, the final operations are removing the photoresist, washing and drying the parts.

The removal of the tin coating can be carried out by chemical means at a temperature of 15-25 ° C in the following solutions:

*Solution number 1*

Hydrochloric acid - 1L

Oxide of antimony - 12 g

Water - 125ml

*Solution No. 2*

Hydrochloric acid - 20-40 g / l

Iron chloride - 160-180 g / l

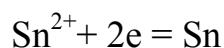
Acid oxalic acid - 50-70 g / l

Acid acetic - 100-120 g / l

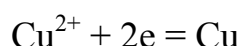
In this diploma project for the purification of waste water, the use of an electrochemical purification method, the benefits of which is the purity of sewage treatment.

As cathodes in electrolyzers for electroextraction of tin and copper, electrodes are used from metallized foam polystyrene or carbon-carbon graphite fibers (IVF). In the diploma project for electrolysis were selected woven VVM, which, in comparison with nonwoven, have a higher resistance to various types of deformations.

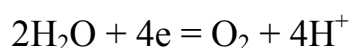
Reaction occurring on a cathode (when purifying from tin):



The reaction on the cathode when cleared from copper:



Anode reaction:



The peculiarity of the processes of electroextraction of metals from waste water is the need to use insoluble anodes, the choice of which is relatively small and their choice is determined by the composition of the effluent that should be exposed to electrochemical treatment.

On the basis of the analysis of the technological scheme, the norms of the technological regime, we determine the necessary volume of automation of the process of tin milling of the printed assembly boards:

- control and regulation of the level of electrolyte in the tub of the dill;
- control and regulation of pH
- control and regulation of the current applied to the electrodes of the grinding bath.

After analyzing the technological part of the diploma project, we see that there is the use of harmful, fire and explosive, chemically aggressive substances and materials, as well as the execution of the project task is impossible without different types of energy: thermal, mechanical, electrical and compressed air energy.

The project complies with all requirements of labor protection and fire safety. This section describes the measures aimed at creating safe and healthy working conditions and ensuring fire safety at the projected facility.