



Low-temperature Gas-phase Metallization of Dielectrics

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ABSTRACT

We developed the technology of applying the conductive films of copper phosphide on the dielectric materials in order to obtain a basis for further metallization. This technology is based on use of phosphine as reducing agent, which can restore the connections of copper to phosphide.

Key words: Dielectrics, Low Temperature, Gas-phase.

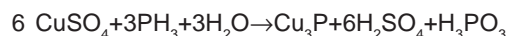
INTRODUCTION

Metallization of dielectrics a new physico-chemical, mechanical and decorative properties is give to them¹⁻⁷.

Depending on the type of dielectric material and on the aims to be coated, have been proposed various methods of metallization, among which was the largest use of chemical-electrolytic metallization^{3,4}. For create a conductive layer in this process the dielectric surface is activated by formation of a catalytic centers, which are then coated by chemical means. At that the active centers consisting of easily reduce metals atoms (copper, silver, palladium), through reduction of metal ions (adsorbed on the surface of dielectric material) by water-soluble or gaseous reducing agent are formed¹⁻⁷. As gaseous reducing agent most commonly used hydrogen, and the reduction reaction at high order of several hundred degrees temperature is carried out.

Chemical-electrolytic technology has limitations associated with use of expensive materials, with use of high temperatures, loss of coating on highly porous materials. Therefore, the development of new methods of metallization of dielectric surfaces is relevant, because such method may be suitable for solving some specific problems of metallization.

We developed the technology of applying the conductive films of copper phosphide on the dielectric materials in order to obtain a basis for further metallization. This technology is based on use of phosphine as reducing agent, which can restore the connections of copper to phosphide.



Obtained copper phosphide belongs to the metal-phosphide, and a good conduct the electricity.

Table 1: The thickness of copper-phosphorus film on various dielectrics and its ability to galvanic plating

S. No.	Basis material	Preliminary preparation	The thickness of the copper-phosphorus film
1.	Polyamide	Etching in solutions: K ₂ Cr ₂ O ₇ -35g/l; H ₂ SO ₄ (98%) -640-680ml; H ₂ O - up to 1liter. Matting in the solution:	0,1-0,2
2.	Glass	NaF-120g/l, CH ₃ COOH-40g/l, C ₂ H ₅ OH-300g/l.	0,5-0,6
3.	Ńeramics	without processing	0,5-0,6
4.	Wood	without processing	0,5-0,6
5.	Tissue	without processing	0,6-0,7

Main processes for metallization of dielectrics with using of copper-phosphoric film: preliminary surface preparation of sample, coating a layer of copper phosphide, galvanical or chemical plating by metal layer.

For obtaining of copper phosphide layer sample was immersed for 3-5 minutes in a solution containing 150-200g/l CuSO₄•5H₂O. Then samples were placed in a sealed chamber from which air is removed by purging with nitrogen and subjected to treatment with phosphine.

Processing by phosphine proceeded at room temperature for several minutes. Remains of unreacted gas was passed sequentially through copper carbonate layer and the oxidation solution (500g/l potassium permanganate). After such treatment in the waste gas phosphine is not detected.

Then sample is removed from the chamber, washed with water and dried at room temperature.

In the issue on the dielectric surface the coatings with thickness of 0,1-0,6μm obtained, depending on the dielectric wettability (Table 1).

At receipt of thin layers of copper phosphide must repeat the above operations until thickness sufficient for the electroplating are form. We have tested the possibility of chemical nickel plating on the surfaces of dielectrics coated with a layer of copper phosphide.

The experimental results showed that copper phosphide film is a catalyst for chemical nickel plating. Thus, after obtaining a layer of copper phosphide on dielectric further covering by metal can be carried out as electroplating and chemical means.

The advantages of low-temperature gas-phase metallization is the possibility of metallization of the inner surfaces of porous dielectrics. So for the metallization of the porous miplast having a volume porosity of 45%, average pore diameter of 15mm sample was impregnated with a solution of copper sulphate and within 4-5 hours, dried at a temperature of 40-50 °C, for gas permeability pores. Then treated by phosphine and obtain the catalytically active surface, which was coated by nickel from the alkaline electrolyte at room temperature.

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