UDC 621,762

Metallographic and electron microscopic methods of research work surfaces contact details

Mrachkovskyy AM, Ph.D., A.Stoyanova, MA

Studied Electrical, thermal, physical and chemical processes that occur on working surfaces contact details at switching current.

A conduct structural analysis materials based on Ag oxide impurities to identify the distribution pattern of hardening additives in the matrix.

Contacts, structural analysis, composites, electrical arc, heterophase structure, silver matrix.

The purpose of research - development of evidence-based measures to improve environmental safety starters and increase their operational reliability through the use of new environmentally friendly and erosion resistant contact materials.

Materials and methods of research. To investigate the electromechanical, thermal, physical and chemical processes occurring on the working surfaces of contact details used in switching power known and developed new methods of manufacturing research relevant experimental facilities and equipment. Microscopy method can significantly extend the idea of the mechanism and kinetics of some processes of powder metallurgy and structure formation, which significantly affects the formation of electric properties of materials.

Results. Microstructural analysis of materials based on Ag oxide impurities reveals a general picture of the distribution of hardening additives in the matrix. The particles of oxides which are introduced in a silver matrix internal oxidation, relatively evenly distributed in the form of point particles.

The microstructure of material samples with the introduction of various oxides such, stands granular matrix structure of light tone, grain shaded second phase, which occurs between their borders.

Studies have shown that with the increase in the oxide matrix appear separate their clusters, the size of the spaces between the grains grow; silver particles are almost completely surrounded by them.

A structure fracture surface of composite materials is closely related to their nature and depends on the particle size of the volume number and strength of the surface distribution.

The final structure low current electrical contacts formed by dispersing structural components and the emergence anisotropic material as a result of directed deformation substructure with simultaneous formation. Formation of anisotropic heterophase structure in multi-part compositions intended distribution in the structure of the thermal conductivity and electrical components lead to high values of electrical and thermal conductivity of the material as a whole, which gives it a high electrical resistance.

Introduction to the silver matrix and Mn oxides In 5% prevents cold deformation. Appears texture by rolling, forming anisotropic structure electro contact material. The addition of Zr in Ag is ductile fracture mechanism.

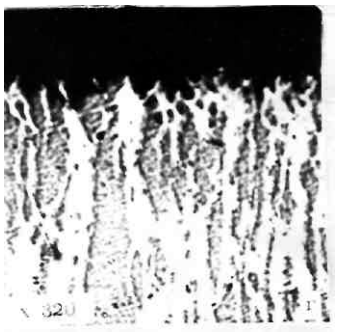
Composite materials reinforced oxides, refractory material, requiring five to tenfold rolling with intermediate annealing for one hour at 600 ° C in air. The processes of plastic deformation electro contact finally form the structure of the material.

Introduction insoluble phases promote intensive grinding grain silver matrix. The particles of insoluble components also crushed (dispersed) and arranged along the deformed grains of silver, while maintaining orientation towards deformation. Chains oxide matrix extracted under deforming forces by changing the shape of grain.

Metallographic and X-ray structure analysis of the working surface of serial contacts. In-depth study of physical processes that occur on the working surface contact during operation aimed at eliminating electric erosion, which is a major cause of their destruction. The microstructure of the material - one of the main factors affecting the properties of the electrical contact. It depends primarily on manufacturing technology, properties of components and design features of the device, energy arc, and the state of the atmosphere.

On picture 1 shows the initial microstructure of the contact material such as NRF-10 electromagnetic starter PML-1100. It is a uniform fine-grained mixture of silver and nickel

phase particles which stretched parallel to the direction of rolling wire, providing anizotropnist physical characteristics.



As we approach the working surface of the grain size of the silver and nickel phase increases due to thermal action of the arc. The working surface of contact is reduced by the amount of silver is much lower than the evaporation temperature nickel.

Pic.1. Microstructure rolling contact with the material NRF-10 electromagnetic starter PML-1100 after 100 000 switching

In places the material, which was silver and cluster beans refractory component nickel, there are small pores and sinks. The depth of the layer in which there microstructural changes is 0.05 - 0.08 mm. How to contact directly the surface and a depth of 0,05mm oxidized nickel.

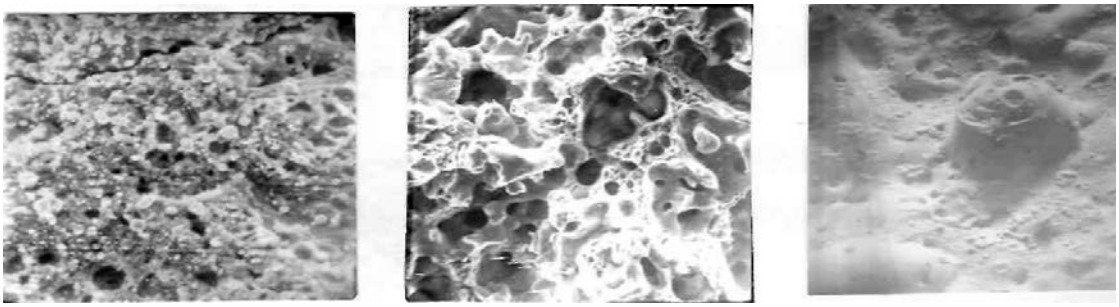
During the electrical contact is melting and evaporation intensive fusible component - silver from the working surface of the cathode, thus forming discrete, rough surface (Picture 2). The degree of roughness depends on the current strength and number of switching.

Pic.2. Appearance rolling contact with the material NRF-10 electromagnetic starter PML-1100 after 100 000 switching

On the surface erosion were major rebellions and cavities in the structure - light inclusions, which according to X-ray analysis are silver. Chemical analysis of the surface layer showed that the amount of nickel on the working surface is significantly increased (from 10 to 20-25%), indicating the priority of silver fumes from the contact surface in the switching power supply.

A detailed study of the working surface contacts revealed that as a result of the arc melts not only fusible composition - silver, but also nickel grains (Picture 3 a), as evidenced by the presence of characteristic stages of solidification at the edges of nickel grains (Picture 3, b) . Thickened nickel grains have a conical shape that is typical bridged transfer (Picture 3, B). On the tops of some nickel grains formed viscous job sites,

indicating that the destruction of the material after adhesion contacts.



а x85 б x300 в x400

Pic. 3. Electron microscopic images surface contact NRF-10 after 100 000 switching

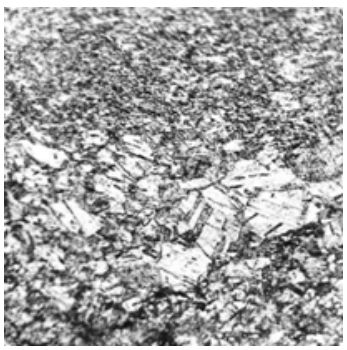
These results imply suggests that contact is made at the last moment to point refractory component, which determines the ability of a material to weld.

Studies have shown that the lowest electrical resistance of a material having contacts CPM-0.2, this composition: Cu (0.1-0.5%); Ni (0,005- 0,2%), Ag - rest. When switching power adapter 4; 6.3 and 10 obhoryannya observed melting and working surfaces contact with this material. Metallographic analysis showed that in the microstructure of the surface layers varies significantly.

On picture 4 shows that the switching current material that is heated to the boiling point, partially transferred to the surface of colder fixed contact, and the rest falls back to the surface rolling, forming a cavity (black craters in the figure) and columnar grains perpendicular to the work surface contact.

Picture 4. Microstructure contact with the material CPM-0.2 after 100 000 switching

The microstructure of immovable and movable contact is different in structure. Figure 5 anode surface is covered with small grains cathode metal vapor, which crystallized in fire electric shock. You can also see increased silver grains, formed as a result of recrystallization temperature under the influence of metal vapor.



When switching DC is directed transfer of material from a fixed movable contact. Consequently, the crater formed at the cathode and the anode - performance.

Picture 5. The microstructure of the material of the anode contact CPM-0.2 after 100 000 switching

Conclusions

1. Structure fracture surfaces of composite materials are closely related to their nature and depend on the particle size of the volume number and strength of the interface.

2. In contact points made on refractory component, which determines the ability of a material to welding.

3. Introduction of additional soluble in a silver matrix phase type oxides and refractory metals allows adjusting the mass transfer at the contact details and increase electrical resistance as a whole.

4. Installed nonlinear dependence of the electrical erosion of current strength of character load, the number of commutations, physical and mechanical properties of the material and its microstructure for materials based on silver.

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