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Wear-resistant Coatings From Electroerosive Micro- and Nanofraction Powders

E.V. Ageeva*, L.P. Kuznetsova, E.V. Ageev, A.Yu. Altukhov, O.V. Vinokurov, V.V. Sirota

South-West State University, 94, 50 let Octyabrya St., 305040 Kursk, Russia

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The results of studies of relative stability of the cutting tool, restoration and strengthening by electric-spark alloying with the using as electrode material the electroerosive tungsten powders are demonstrated. The efficiency of their application is shown.

Keywords: Hard alloy, Electroerosive dispersion, Powder, Wear-resistant coating.

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1. INTRODUCTION

Restoration and hardening of the cutting tool is an important national economic task, as provides economy of high-quality metal, fuel, energy and labor resources, as well as rational use of natural resources and environmental protection. The extensive use progressive methods of restoration and strengthening in the repair allows to save in the scale of the country hundreds of thousands of tons of metal.

Recovery of tool with a high level of reliability and required resource – it is a complex and urgent task. This task can be solved through the use of effective methods of surface hardening in restoring by the use of special wear-resistant materials, providing reception of coatings with specified physical properties. Such materials are primarily modern tungsten hard alloys.

One of the main problems of using hard alloys is currently recycling their waste and reuse. Numerous attempts to withdraw tungsten from the composition of hard alloys, due to its high cost, did not complete successfully, because neither of refractory compounds can provide such high strength characteristics. Therefore the problem of hard alloys waste recycling is currently very relevant [1-4].

Industrially used method of hard alloys waste processing is based on chemical and metallurgical processes and differ large-capacity, energy content, large production facilities, environmental problems (waste water, emissions).

One of the most perspective and industrially not used methods of hard alloys waste processing, characterized by rather low energy consumption and environmental friendliness of the process, is a method of the electroerosive dispersing (EED) [5-10].

For the development of hard alloy obtaining technology from powders, obtained from tungsten waste by electroerosive dispersing, and evaluating the effectiveness of their use carrying out of complex theoretical and experimental studies is required.

The purpose of the work was the investigation of relative stability of the cutting tool, restored and hardened by electric spark alloying, using electroerosive tungsten powders as an electrode material.

2. MATERIALLY AND METHODS

As the material for obtaining the cylindrical hardmetal electrodes was selected powder, produced from waste of hard alloy T15K6 in illumination kerosene. Samples of blanks from electroerosive hardmetal powders was obtained by hot pressing with a passing of high current in vacuum at 1320 °C for 3 min, from the powder, prepared by electroerosive dispersing of waste hard alloys T15K6. The process is based on a modified hot-pressing method, in which an electric current is passed directly through the mold and compressible preform, rather than through an external heater. With a pulse of electric current and the so-called «effect of the plasma spark discharge» («spark plasma effect») very rapid heating and extremely low cycle times are achieved. This allows you to suppress the grain growth and get the equilibrium state, which opens up opportunities for the development of new materials with previously unavailable compositions and properties of materials with submicron or nanoscale grain, as well as composite materials with unique or unusual compositions.

3. EXPERIMENTAL RESULTS AND DISCUSSION

The picture from REM of microstructure and elemental composition of the alloy, synthesized from powder, obtained by electroerosive dispersing tungsten waste in water, is shown in Fig. 1.

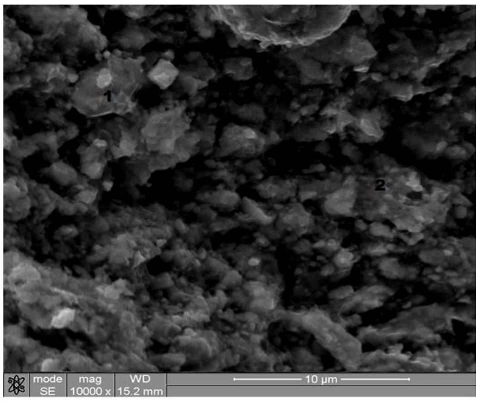
The points in the figures correspond to the spectrums of characteristic X-ray. On the spectrum each chemical element corresponds to the peak of a certain height.

Then at the points 1, 2 and 3 indicated on the resultant image spectrums characteristic X-ray were obtained on the surface of the sample.

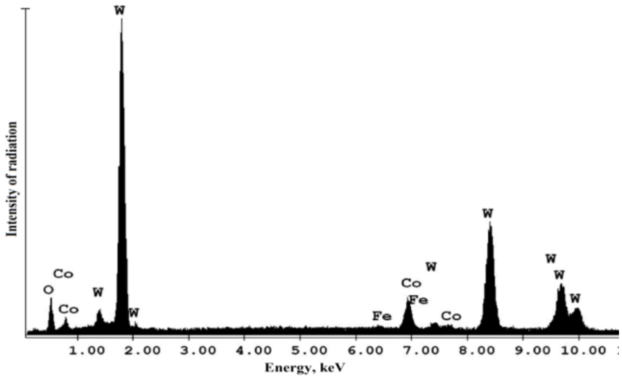
According to the results of presented generalized data it was established that the basic elements in the powder, obtained by electroerosive dispersing of tungsten waste in distilled water, and in the alloy, synthesized from it, are tungsten, molybdenum, iron, oxygen and carbon.

The obtained electrodes were tested and implemented for hardening the cutting tool by electrospark alloying (Figs. 2, 3, 4).

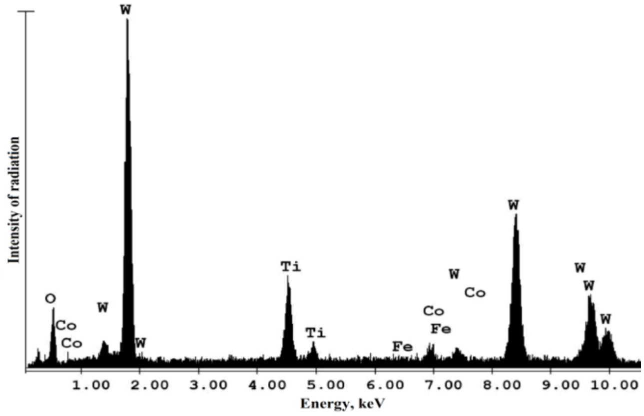
* ageeva_ev@mail.ru



a

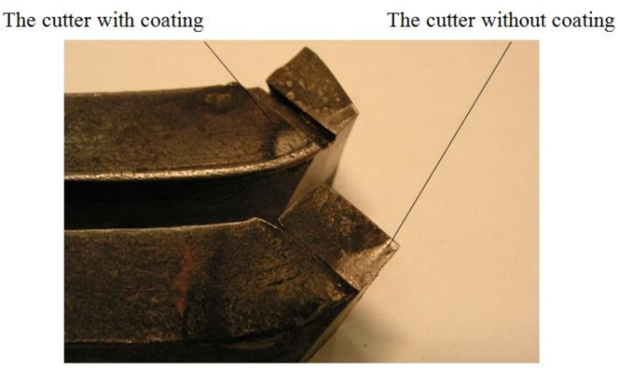


b



c

Fig. 1 – Microstructure a) and elemental composition of hard alloy, synthesized from the powder, obtained by electroerosive dispersing in water b) at point 1; c) at point 2



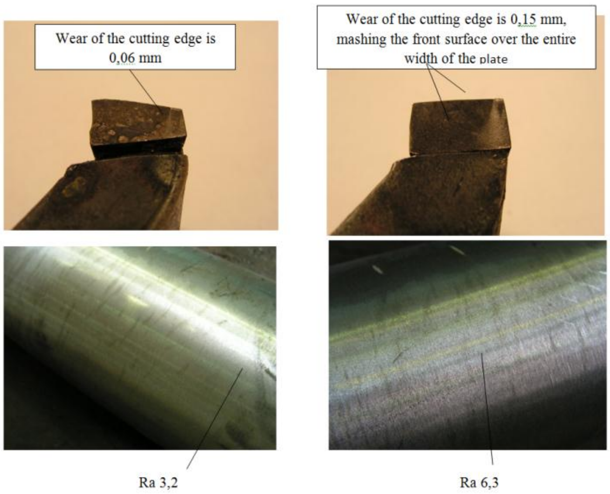


Fig. 2 – Strengthening of the passage cutter

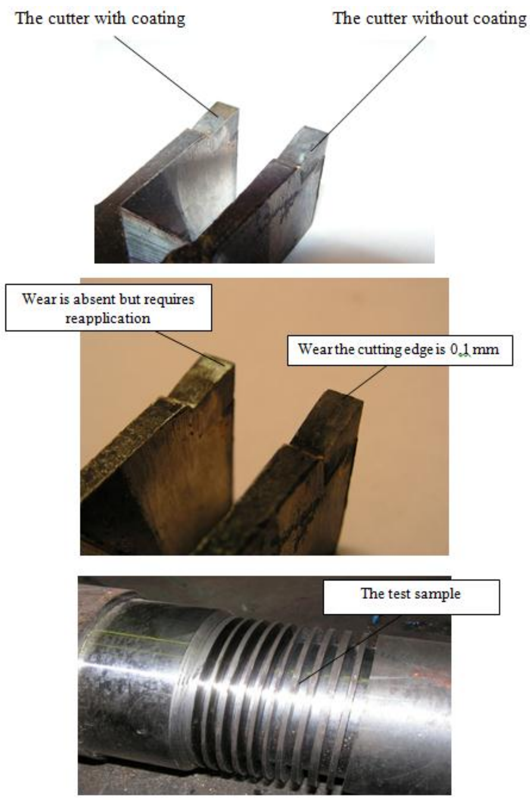
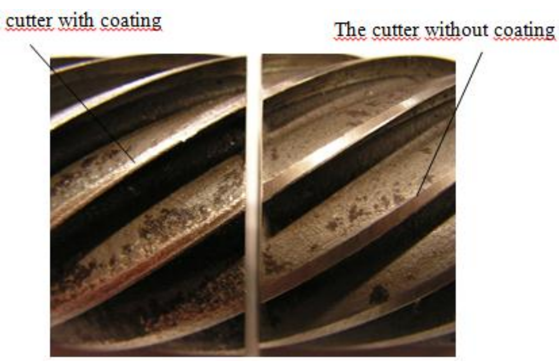


Fig. 3 – Hardening of the cutting tool



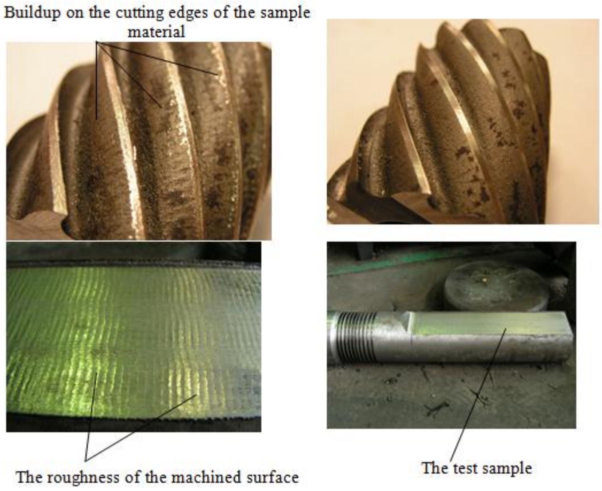


Fig. 4 – Strengthening of cylindrical cutter

Thus, production tests showed a high efficiency of hardening the cutting tool by electrospark alloying, using the solid alloy, obtained from tungsten waste by the method of electroerosive dispersion, as electrode material. Moreover, the resistance of the cutting tool increased in 3,8...4,8 times.

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