

X-ray spectral microanalysis of W-Ni-Fe pseudoalloy obtained from electroerosive powders

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Abstract. The results of X-ray spectral microanalysis of W-Ni-Fe pseudo-alloy, obtained from electroerosive powders, are presented. Consolidation of the obtained electroerosive powders was carried out by the method of spark plasma sintering using the SPS 25-10 spark plasma sintering system. Using an EDAX energy-dispersive X-ray analyzer built into a Quanta 600 FEG scanning electron microscope, characteristic X-ray spectra were obtained at various points on the sample surface and along a transverse section. As a result of the study, it was found that on the surface of the investigated sintered sample, tungsten, nickel and iron are contained as the main elements, and oxygen, copper and chromium are also present in small amounts.

1 Introduction

Pseudo-alloys W-Ni-Fe are widely used in industry, and as a result, there is a problem with the processing of their waste and reuse [1-8].

The existing technologies for the production of W-Ni-Fe alloys are characterized by large tonnage, energy intensity, large production areas, low productivity, and environmental problems. One of the main problems in the use of these alloys at the present time is waste processing and further use. Numerous attempts to remove tungsten from these alloys, due to its high cost, have not ended successfully, since none of the refractory compounds provides such high strength characteristics. Therefore, the problem of utilization of waste alloys W-Ni-Fe is currently very relevant.

One of the most promising methods of disposal of almost any electrically conductive material, including the W-Ni-Fe alloy, characterized by relatively low energy consumption and environmental friendliness of the process, is the method of electroerosive dispersion (EED) [9-11].

The relevance of the work is determined by the important economic task of creating progressive, environmentally friendly, energy-saving and waste-free technologies for producing powders, including nanoscale ones, and their practical application.

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Complex theoretical and experimental studies are required to develop technologies for producing products from powders, obtained from W-Ni-Fe wastes and to assess the efficiency of their use. The EED method is one of the promising methods for producing powders from almost any conductive material, including from ball-bearing steel waste, and is characterized by relatively low energy consumption and environmental friendliness of the process [12-18].

Carrying out the planned measures will allow solving the problem of waste disposal and their further use and thereby reduce the cost of the final product.

2 Materials and methods

Waste (shavings) of the W-Ni-Fe alloy were selected to carry out the planned studies. Distilled water (GOST 6709-72) was chosen as the working liquid, since it has the simplest chemical composition, a sufficiently high cooling capacity, and also a relatively low cost.

To disperse the wastes of the alloy (chips) of the W-Ni-Fe alloy, an installation protected by RF Patent No. 2449859 was used. Dispersion modes were as follows: pulse repetition rate 100 Hz; voltage 100 V; the capacity of the discharge capacitors is 24 μ F.

Scanning electron microscopy was used to study the microstructure of the sample (along the surface and along the transverse section). The surface (along the section) of the sample was ground and polished. Grinding was carried out with metallographic paper with coarse (No. 60-70) and fine grain (No. 220-240). During grinding, the sample was periodically rotated by 90°. The abrasive particles were washed off with water and subjected to polishing on a wheel with suspensions of metal oxides (Fe_3O_4 , Cr_2O_3 , Al_2O_3). After reaching a mirror finish, the surface of the section was washed with water, alcohol, and dried with filter paper. Using an EDAX energy-dispersive X-ray analyzer built into a Quanta 600 FEG scanning electron microscope, characteristic X-ray spectra were obtained at various points on the sample surface and along a transverse section.

Consolidation of the obtained electroerosive powders was carried out by the method of spark plasma sintering using a spark plasma sintering system SPS 25-10 (Thermal Technology, USA).

3 Results and Discussion

The location of the X-ray spectral microanalysis is shown in Figure 1.

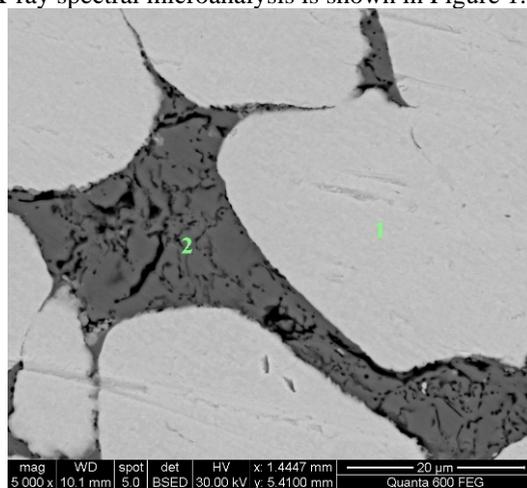


Fig. 1. X-ray spectral microanalysis location

The elemental composition at point 1 is shown in Figure 2 and Table 1.

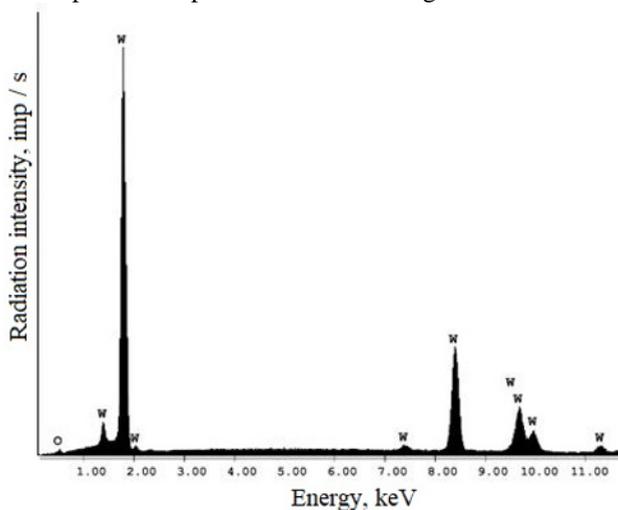


Fig. 2. Elemental composition at point 1

Table 1. Elemental composition of the sintered sample at point 1

Element	Mass fraction,%	Atomic fraction,%
O	1,41	14,12
W	98,59	85,88
Total	100,00	100,00

As a result of the studies, it was found that on the surface of the investigated sintered sample at point 1, tungsten is contained as the main element, and oxygen is also present in a small amount.

The elemental composition at point 2 is shown in Figure 3 and Table 2.

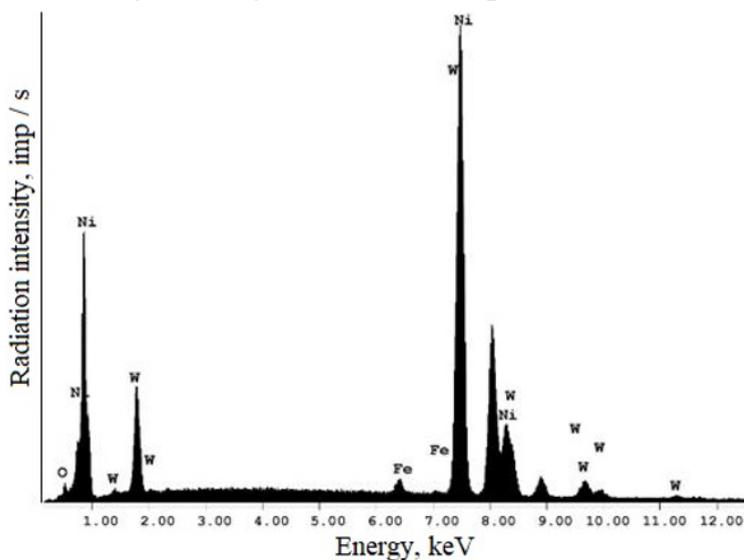


Fig. 3. Elemental composition at point 2

Table 2. Elemental composition at point 2 of the sintered sample.

Element	Mass fraction,%	Atomic fraction,%
O	2,57	10,44
Fe	1,14	1,63
Ni	71,48	79,24
W	24,56	8,69
Total	100,00	100,00

As a result of the studies, it was found that on the surface of the sintered sample under study at point 2, tungsten, nickel and iron are contained as the main elements, and oxygen is also present in a small amount.

As a result of the study, it was found that on the surface of the investigated sintered sample, tungsten, nickel and iron are contained as the main elements, and oxygen, copper and chromium are also present in small amounts.

The experiment showed that the average particle size is 23.86 microns.

4 Conclusion

Carrying out the planned measures will allow to solve the problem of waste disposal of W-Ni-Fe alloys and their further use and thereby reduce the cost of the final product.

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