JOURNAL OF NANO- AND ELECTRONIC PHYSICS
Vol. **7** No 4, 04080(3pp) (2015)

ЖУРНАЛ НАНО- ТА ЕЛЕКТРОННОЇ ФІЗИКИ
Том **7** № 4, 04080(3cc) (2015)

Electroerosive Powder Obtained from Alloy VK8 Waste into Butanol

E.V. Ageev[1,*], A.Yu. Altukhov[1], S.V. Khardikov[1], S.S. Gulidin[1], A.N. Novikov[2]

[1] *South-West State University, 94, 50 let Octyabrya St., 305040 Kursk, Russia*
[2] *Priokskii State University, 29, Naugorskoe highway, St., 302020 Orel, Russia*

(Received 02 October 2015; published online 24 December 2015)

The results of studies of the properties of the powders obtained by electroerosive dispersing of the hard alloy wastes of mark VK8 in butanol. It is found that the powder particles obtained by electroerosive dispersing of waste carbide grade VK8 in butyl alcohol, consist of the following major elements: W, Co, Fe, C and O.

Keywords: Electroerosion powders, Butyl alcohol, Elemental composition.

PACS numbers: 61.05.cp, 81.07.Wx

1. INTRODUCTION

Modern hard alloys are widely used in engineering. They are made from base of a tungsten carbide, titanium, tantalum or combinations of these carbides. As a binder in alloys are cobalt, nickel and iron. Hard alloys are obtained by pressing and sintering the mixture. Until now the problem with using of hard alloys is the processing of their waste and reuse. Numerous attempts to replace tungsten in the composition of hard alloys did not provide the high strength properties. So up to now the problem of waste recycling carbide remains actual [1-4].

One of the progressive and industrially not used methods of produce a powder from any conductive material, which is characterized by low cost of electricity and the lack of pollution, is the method of electroerosive dispersion (EED) [5-18].

Thus, solution to the problem associated with the recycling and reuse of hard alloys wastes in the production of new plates is only possible in solving a number of related scientific problems of theoretical and experimental nature, which determines the actuality and scientific value of research in this area.

The aim of this work was to study the properties of powders produced by electroerosive dispersing of hard alloy wastes of mark VK8 in butanol.

2. MATERIALLY AND METHODS

To perform the planned studies plant for EED [17, 18] and wastes of hard alloy VK8 were used. The wastes were charged into the reactor filled with working fluid - butyl alcohol (1-butanol), the process is conducted under the following electrical parameters: Voltage – 150 V, capacitance of discharge capacitors – 45 mF, pulse repetition rate – 200 Hz.

Butyl alcohol (1-butanol) C_4H_9OH – representative of monoalcohols. A colorless, slightly viscous liquid with a characteristic smell of fusel oil. It can be mixed with organic solvents. Butanol is used: as a solvent in the paint industry, in producing of resin and plasticizers, for obtaining butyl acetate and butyl acrylate and esters with glycols, for the synthesis of many organic compounds.

As a result of local influence of short electric discharges between electrodes in alcohol destruction of hard alloy wastes with forming dispersed particles of powder has happened.

3. EXPERIMENTAL RESULTS AND DISCATIONS

Research of the elemental composition of samples of the powder were carried out on electron-ion scanning (raster) microscope (SEM) with a field emission of electrons «QUANTA 600 FEG» and energy-dispersive X-ray analyzer of the company «EDAX».

QUANTA 600 FEG (manufacturer FEI (Netherlands)) - electron-ion scanning microscope with an electron beam column, equipped with a tungsten cathode, accelerating voltage of 200 eV to 30 kV, the resolution (under optimal WD) 3,5 nm at 35 kV; 3.5 nm at 30 kV in the mode of the natural environment; < 15 nm at 1 kV in a low vacuum. The ionic column Magnum is with gallium liquid metal ion source, accelerating voltage of 5 kV to 30 kV, the resolution of 20 nm. The system has 5-axis motorized table 50 × 50 × 25 mm, gas injection systems for deposition of conductors and insulators, and also for etching of samples.

The microscope allows for obtaining images of various objects with an increase of more than 100,000 multiplicity, with a large number of elements of the expansion (pixels). It is intended to perform various studies in minimal time on the preparation of objects, providing observation of them with an exceptional depth of field. The following are the results of experimental studies.

Fig. 1 shows REM images of particles with a powder, obtained by EED of hard alloy wastes in butanol.

From these figures it is seen that the obtained powder particles mainly have spherical and elliptical forms. It is noted that such particles are obtained by crystallization of the molten material (liquid phase). At the same time, there is a particle agglomerates whose size is much less. They are formed during the crystallization of the fluidized material (vapor).

Results of the study of the elemental composition of the powder obtained by electroerosive dispersion from alloy VK8 in butanol, are presented in Fig. 2 and Table 1.

* ageev_ev@mail.ru

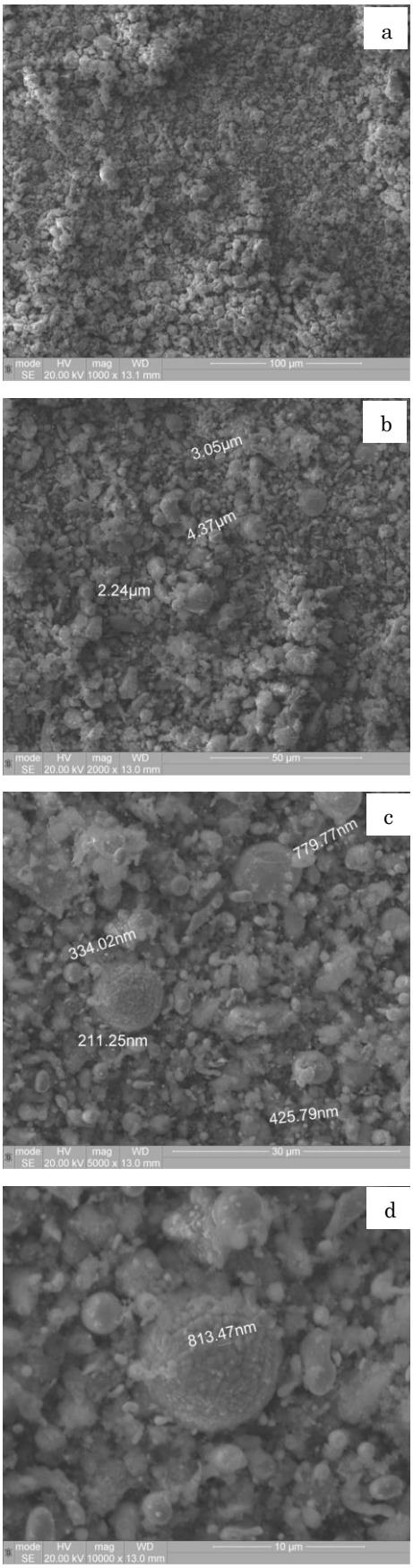

Fig. 1 – Images from REM of particles powder obtained by EED

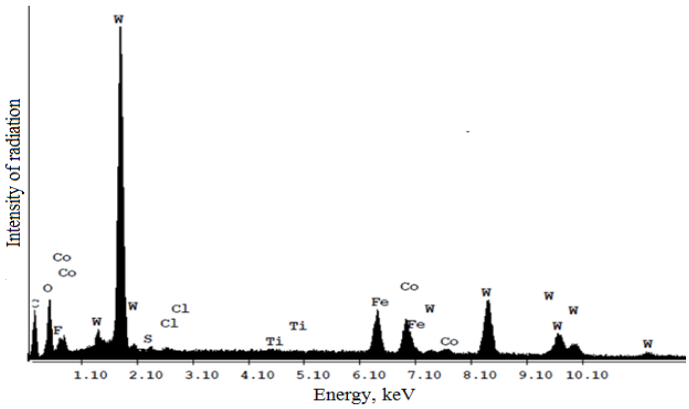

Fig. 2 – The spectrogram of the elemental composition of powder obtained by EED hard alloy VK8 in butanol

Table 1 – The elemental composition of powder obtained by electroerosive dispersion of alloy VK8 in butanol

Element	Mass fraction, %	Atomic proportion, %
C	13,70	50,71
O	7,04	19,55
F	0,86	2,02
S	0,11	0,15
Cl	0,26	0,32
Ti	0,34	0,32
Fe	7,91	6,29
Co	7,37	5,55
W	62,41	15,09
Total	100,00	100,00

From these data revealed that the powder particles obtained by electroerosive dispersing of wastes hard alloy mark VK8 in alcohol 1-butanol, consist of the following major elements: W, Co, Fe, C and O.

Thus, the study of the properties of the powders obtained by electroerosive dispersing of hard alloy wastes mark VK8 in butanol-1, will contribute to solving the problems associated with the recycling and reuse of hard alloys wastes in the manufacture of new plates with high operational properties.

The work is executed by theme of the state task of the Russian Ministry (project No 2104).

REFERENCES

1. S.B. Maslenkov, *All materials. Encyclopedic Reference* No 1, 18 (2007).
2. V.A. Falkowski, F.I. Falkowski, V.S. Panov, *Non-Ferrous Metal.* No 10, 85 (2007).
3. T.B. Ershova, M.I. Dvornik, A.V. Zaitsev, *Composite. Nanostruct*. No 2, 40 (2011).
4. V.I. Tretyakov, *Basics of metallurgy and production technology of sintered hard alloys* (Moskow: Metallurgy: 1976).
5. N. Hertel, *Ferrous Metal*. No 2, 50 (2012).
6. E.V. Ageev, A.S. Osminina, E.V. Ageeva, *J. Nano- Electron. Phys.* **5** No 4, 04038 (2013).
7. E.V. Ageev, A.V. Kirichek, A.Yu. Altuhov, E.V. Ageeva, *J. Nano- Electron. Phys.* **6** No 3, 03001 (2014).
8. E.V. Ageeva, E.V. Ageev, N.M. Horyakova, V.S. Malukhov, *J. Nano- Electron. Phys.* **6** No 3, 03011 (2014).
9. E.V. Ageeva, E.V. Ageev, V.Yu. Karpenko, A.S. Osminina, *J. Nano- Electron. Phys.* **6** No 3, 03049 (2014).
10. E.V. Ageev, R.A. Latypov, *Russ. J. Non-Ferrous Metal.* **55** No 6, 577 (2014).
11. E.V. Ageeva, E.V. Ageev, N.M. Horyakova, *Russ. Eng. Res.* **34** No 11, 694 (2014).
12. E.V. Ageeva, E.V. Ageev, N.M. Horyakova, *Russ. Eng. Res.* **35** No 1, 33 (2015).
13. E.V. Ageev, R.A. Latypov, E.V. Ageeva, *Russ. J. Non-Ferrous Metal.* **56** No 1, 52 (2015).
14. E.V. Ageeva, E.V. Ageev, V.Yu. Karpenko, *Russ. Eng. Res.* **35** No 3, 189 (2015).
15. E.V. Ageeva, I.A. Avilova, N.M. Horyakova, *Appl. Mechan. Mater.* **770** No 1, 23 (2015).
16. E.V. Ageeva, E.V. Ageev, A.S. Osminina, *J. Nano- Electron. Phys.* **5** No 4, 04038 (2013).
17. E.V. Ageev, The patent 2449859, the Russian Federation, C2, B22F9/14. No 2010104316/02; appl. 08.02.2010; publ. 10.05.2012. - 4 p.
18. E.V. Ageev, E.V. Ageeva, *Herald Eng*. No 11, 51 (2013).