TEST Engineering & Management

*March-April 2020*
*ISSN: 0193-4120 Page No. 844 - 848*

# Study of Morphology and Dimensions of Ultra-Dispersed Powders of Tungsten by Crystal-Optical Method of Discharge

**Rasulov. A.Kh.**-Associate Professor of the department of "Materials Science", Doctor of Philosophy in Technical Sciences (PhD), TSTU,
**Nurmurodov. S.D**.-Professor of the department of Material Science, Doctor of Technical Sciences, TSTU,
**Allanazarov. A.A.**-Scientific researcher of the department of "Materials Science", TSTU,
**Chulliev. Z.F.**-Master student of the department of "Materials Science", TSTU,
**Jalilov. R.R.**- Master student of the department of "Materials Science", TSTU

***Article Info***
***Volume 83***
***Page Number: 844 - 848***
***Publication Issue:***
***March - April 2020***

***Article History***
***Article Received**: 24 July 2019*
***Revised**: 12 September 2019*
***Accepted**: 15 February 2020*
***Publication**: 12 March 2020*

***Abstract:***
The article discusses the results of scientific research on the morphology and dimension of ultrafine tungsten powders by the crystal-optical method of sprinkling obtained by the plasma-chemical method using a ПУВ–300 hydrogen-plasma reduction unit. Analysis of the research results showed that the method for producing tungsten powders affects the shape and size, as well as the particle size distribution of the powders.

***Keywords:*** *morphology, dimension, ultrafine powder, tungsten, tungsten powder, crystal-optical method, powdering, composition, granulometry, size, shape, structure..*

## INTRODUCTION

The development of the metallurgical industry is inextricably linked with the solution of urgent scientific and technical problems of great importance. These include the creation of structural materials with enhanced performance characteristics.The results of studies conducted in many countries indicate the real possibility of using highly dispersed powders of refractory metals for the manufacture of carbide tools, tool and other materials with enhanced performance characteristics. However, more detailed studies on the introduction and modeling of the composition of hard alloys to improve the mechanical properties have shown that carbide tools using highly dispersed powders of refractory metals, in particular composites, have not yet been adequately studied. In this regard, the study of the morphology and dimension of ultrafine tungsten powders obtained by plasma-chemical technology is of particular importance [1].Replacing in the process of processing large powders with ultrafine powders allows to reduce the sintering temperature of the workpieces and makes it possible to obtain a more uniform and fine-grained structure of sintered products.

The object of the studyis the technological process of producing ultrafine powders (UFP) of tungsten at the PUV-300 hydrogen-plasma reduction unit and the manufacture of hard alloys from them - BK6, BK8, BK15 grades (GOST 3882–74) and carbide inserts with service fully important characteristics [6].The research method is the crystal-optical method of scattering.The obtained scientific results and their analysis. The macroscopic characteristics of the samples of UFP tungsten are investigated. Grain UFP tungsten has a chipping character. They have an angular appearance, are generally isometric. However, there are also grain elongated in one direction. The length of such grains does not exceed a width of more than 2–3 times. The sizes of most grains are in the range of 3-5 microns, distributed unevenly in different parts of the scattering. There are deviations in size in both directions from the

*March-April 2020*
*ISSN: 0193-4120 Page No. 844 - 848*

average, i.e. there are grains with sizes below 3 microns and more than 5 microns. But such grains do not occupy large volumes. The shape of the grains is not correct, along with rounded and oblong, there are also hypidiomorphic ones with 2-3 flat and even faces. Many of these grains have a tetragonal (square) shape. Because of the distortion of such forms, sometimes in larger grains, their rhomboid sections arise. The type of scattering under reflected light reveals their heterogeneous density. Along with weakly reflecting light gray and dark gray, almost black areas, some parts of the grains intensely reflect light, which makes them appear white. Such reflective surfaces of part of the grains or the whole grain appear in polarized reflective light, which indicates the heterogeneity of the color. In transmitted light, all grains appear black [2].In the first screening of 1 WC powder, as can be seen from Figs. 1 and 2, coarser fractions of the powder appeared in a glass slide. In the second scattering (Fig. 4), the transmitted light is not polarized. The change in tonality of the color of grains here is associated with their thickness: thicker ones appear black, and less thick ones appear light gray. The presence of white areas among the grains indicates their phase heterogeneity [3].

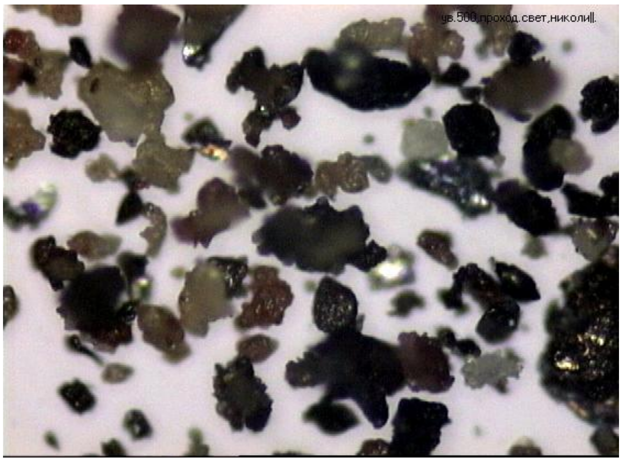

**Fig. 1. View of the second powder distribution of 1 WC under a x2500 microscope**

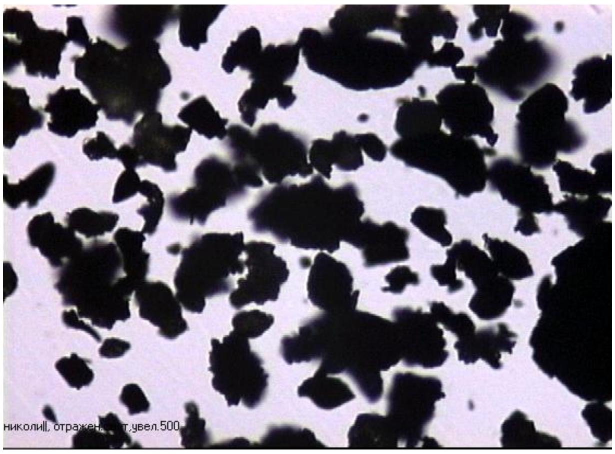

**Fig. 2. Powder powder 1 WC in reflected plain light x2500**

Similar patterns are repeated on other scatterings, figures 3-5 of which are given below.

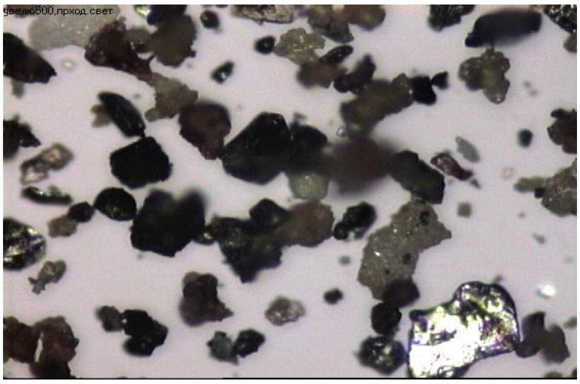

**Fig. 3. Morphology and sizes of crystals of powder 4 micropowder1 WC under x2500 microscope**

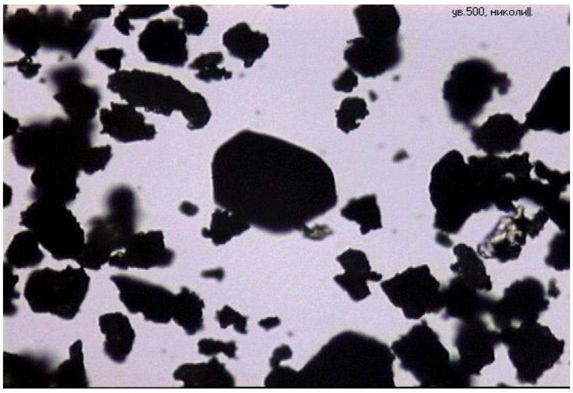

**Fig. 4. Morphology and sizes of crystals of powder 5 x 2500**

**Sample 2 WC,** History is a collection of past events. All fields have its own historical background. As history occurrence shows the errors of the past issues, human being can accurate their forth coming

March-April 2020
ISSN: 0193-4120 Page No. 844 - 848

steps and can get knowledge with self-control in their upcoming steps. Digital history aids all types oas well as other samples of powders, was characterized macroscopically. Here are the macroscopic features of 2WC powder grains. Unlike the other powders presented, this powder turned out to be finer granular, with a pronounced xenomorphism of fragments (shapelessness). However, sometimes among the powder there are individual ideally faceted shapes in the form of a cubic crystal whose dimensions do not exceed 0.001 mm. In transmitted light, along with completely isotropic grains, anisotropic and partially anisotropic particles are found. Most anisotropic particles have nanometric dimensions. It is impossible to determine whether they are an independent phase or represent fragments of larger clastic grains, because in X-ray spectral analysis, it is impossible to induce probe electrons on them due to the small grain size [4].

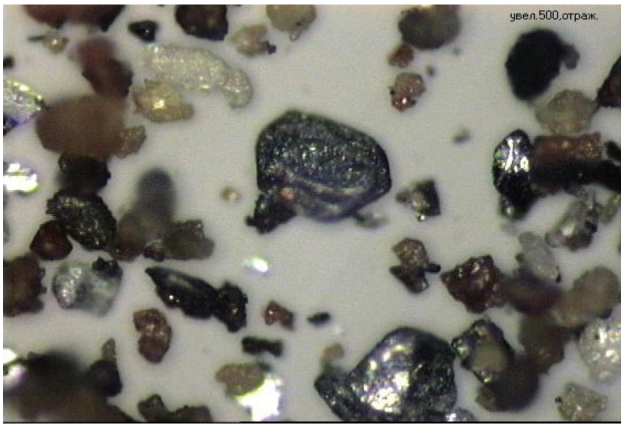


**Fig. 5. Morphology and sizes of powder crystals 5 x500**

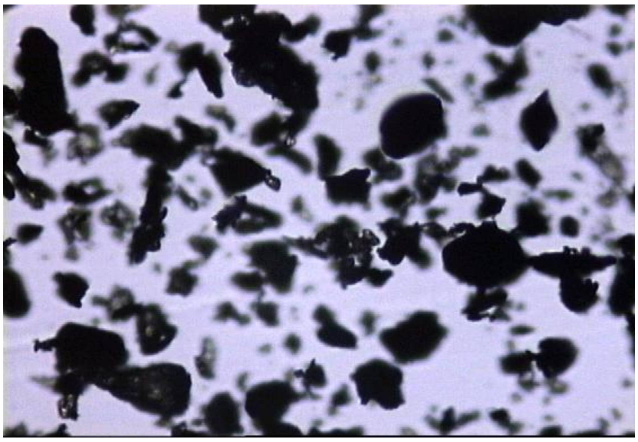

**Fig. 6. Morphology and grain size of the powder 2 WC (powder 2 WC – a) x500**

As can be seen from the above figures, among the grains of powder 2 WC there are also large, columnar, prismatically elongated anisotropic grains. Sometimes they have a lenticular shape resembling crystals of chiastolites in natural rocks.

In general, the similar nature of morphology, consisting in a sharp xenomorphism of small and relatively idiomorphic large grains of powder, is preserved in dry powder.

Figures 6–8 show the features of the morphology and compositional boundaries of dry powder of 2 WC powder.

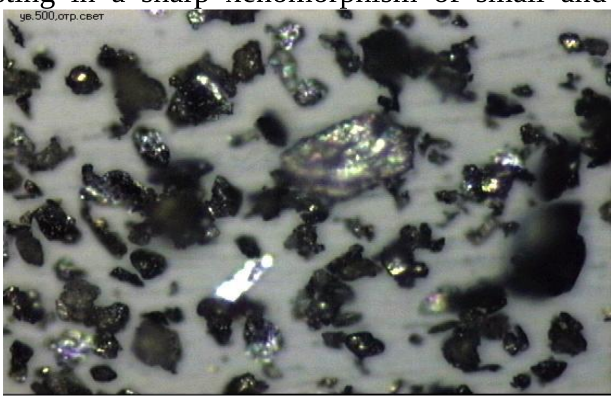


**Fig. 7. Morphology and grain size of the powder 2 WC (powder 2 WC – d) x500**

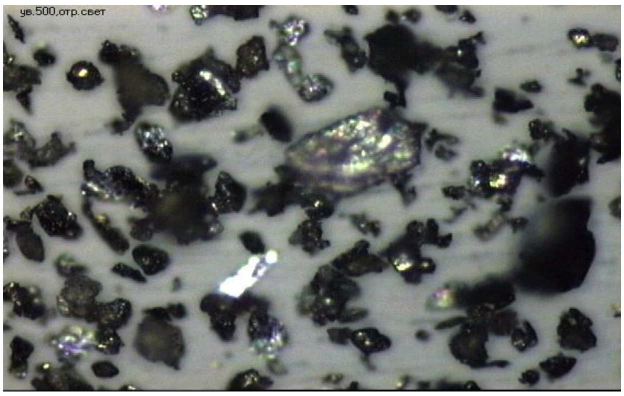


**Fig. 8. Morphology and grain size of the powder 2 WC (powder 2 WC – W) x500**

Ultrafine tungsten powders are a fine-grained black mass. Macroscopically it seems that all grains are equal, uniformly clastic. A comparison of the particle size distribution with the dimension of abrasive micropowders under a binocular magnifier shows their proximity to the sizes of micropowders

M – 5 and M – 8. Therefore, we can conclude that the presented powder does not reach nanometric dimensions in the bulk. However, the presence of particles of nanometric dimension is not excluded [5].

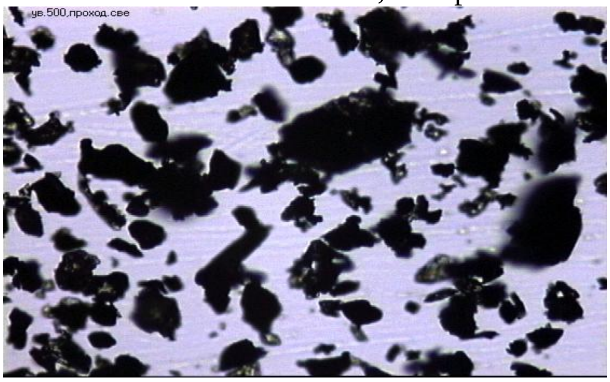


**Fig. 9. Morphology and grain size of 2WC powder (2 WC – e powder)**

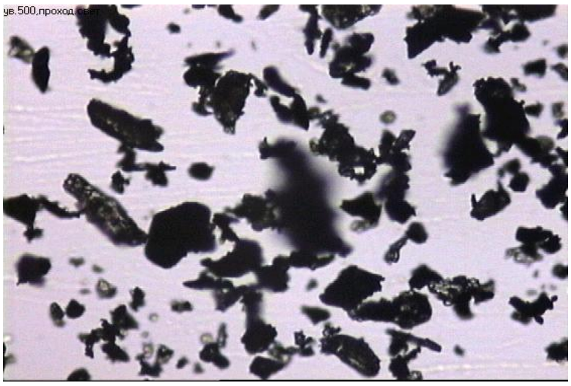

**Fig. 10. Morphology and grain size of 2 WC powder (2 WC – z powder)**

Such particles, due to the high surface energy, form cloud dimming between larger grains around large grains, sometimes also forming small clumps without a definite shape. In fact, such dusty nanoparticles have different degrees of compaction confined to the surface of large grain particles, often square sections, which often break in small differences, forming more or less developed rounded outlines. Small grains tend to coagulate, forming chains and islets-heaps, consisting of various amounts in the range of 2-10 pcs.

In reflected light, they often stand out in the form of white spots. Moreover, the reflecting surfaces of isometric, quasi-square grains are sharper than the triangular and rounded surfaces of the faces of large grains.A gradual decrease in the degree of reflection around large crystals is associated with partial reflection of light and nanoparticles surrounding or adhering to the surface of large grains. A gradual decrease in the intensity of white light around such grains indicates a different degree of compaction, decreasing from grain to the surrounding space.

Based on the research work on the morphology and dimension of ultrafine tungsten powders by the crystal-optical method of sprinkling obtained by the plasma-chemical method on the installation of hydrogen-plasma reduction PUV-300, the following conclusions are presented:

1. The morphology and dimension of the UDP of powders by the crystal-optical method of scattering were studied.
2. The characteristics of ultrafine tungsten powders are given.
3. The macroscopic characteristics of the samples of UDP tungsten were studied.
4. The method of producing tungsten powders affects the shape and size, as well as the particle size distribution of the powders.

## References

1. Salokhiddin. D. Nurmurodov, Alisher. K. Rasulov, Nodir. D. Turahadjaev, Kudratkhon. G. Bakhadirov. Development of New Structural Materials with Improved Mechanical Properties and High Quality of Structures through New Methods Canadian Journal of Materials Science Research, Vol. 5, No. 3, 2016, pp 52 -58.
2. Salokhiddin. D. Nurmurodov, Alisher. K. Rasulov, Nodir D. Turahadjaev, Kudratkhon G. Bakhadirov. “Development of New Structural Materials with Improved Mechanical Properties and High Quality of Structures through New Methods Using New Type of Plasma Chemical Reactor. American

*March-April 2020*
*ISSN: 0193-4120 Page No. 844 - 848*

Journal of Materials Engineering and Technology Vol. 3, No. 3, 2015, pp 58-62.

3. Nurmurodov. S. D., Rasulov. A.Kh. The study of fine powders of refractory metals. // Chemistry and chemical technology. - Tashkent, 2012. № 3, P.55–58.
4. Nurmurodov. S.D., Rasulov. A.Kh. Creation of structural materials using ultrafine tungsten powders. Monograph - Tashkent, Tashkent State Technical University, 2015.168 p.
5. Nurmurodov S.D., Rasulov and others. Patent, IAP 04732. 26/06/2013, Plasma-chemical reactor.
6. Norkudjayev F.R., AlikulovA.Kh., AbdurakhmonovKh.Z., TursunovT.Kh. Examination of Thermophysical Processes in the Creation of Metal Layered Compositions. International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-8 Issue-2S10, September 2019. p361-366.