THE DEVELOPMENT OF TECHNOLOGY FOR DISPERSION-STRENGTHENED MATERIAL BASED ON ALUMINUM AND ITS MICROSTRUCTURAL ANALYSIS

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To reduce the cost of production of dispersion-strengthened composite material (DSCM) developed a fundamentally different technology of producing the dispersed-strengthened composite materials based on aluminum, which is based on the process of burning of the aluminum melt when interacting with oxygen or oxygen – nitrogen mixture. In general, this process is based on the following technologies: the oxygen-converter process, the casting of aluminum alloys in an oxygen atmosphere and the creation of an air-independent power plant based on high-metallised fuel [1].

The difference of the proposed work is a lower cost source components and simplified design of the installation of the ceramic phase. Reducing the cost of raw materials is due to the refusal of the powdered components and the application of the melt, which is much cheaper. Besides the hardware part, the purge unit is also significantly cheaper installations of sintering, self-propagating synthesis or mechanical alloying.

For the experiments on the creation of a dispersion-strengthened material designed and manufactured a stand for receiving and casting of the alloy of a given composition. In the experimental work as the matrix material used aluminum grade A6 (99,6 Al; impurities, mainly Fe, 0.25% and Si of 0.18%) to eliminate the influence of alloying elements and the study of the hardening of the composite is only due to the particles of the reinforcing phase. The study of structural-phase state of the obtained material was performed using methods of optical metallography (KEYENCE VHX-1000) and x-ray analysis [2-6].

The result of metallographic and x-ray crystallographic studies established that the obtained metal-ceramic matrix material is aluminum, the main phase of alumina, aluminum nitride. Completeness of the reaction of oxidation or nitration adjustable process time and variation in the construction of the purge unit, the size of particles by changing the design of the purge unit and the conditions of crystallization. This allows to largely change mechanical properties of the resulting products from the "soft" matrix, with separate inclusions of pottery, to a monolithic ceramic material.

Analysis of the microstructures shown in Fig. 1-4, shows an almost uniform distribution of the reinforcing ceramic phase in the metal. Moreover, the predominant form of the reinforcing element globular.

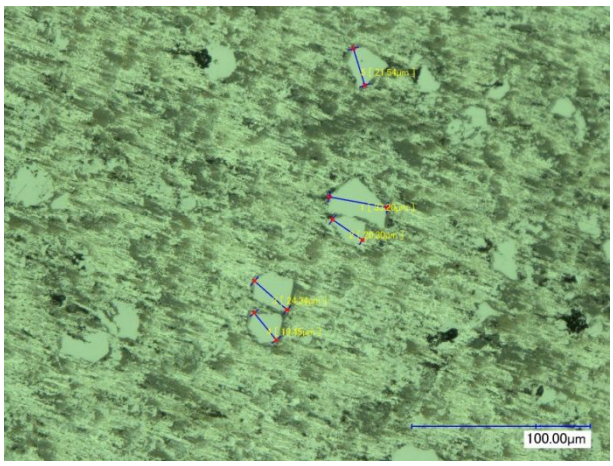

Fig. 1. Sample 1. The average particle size 39 µm

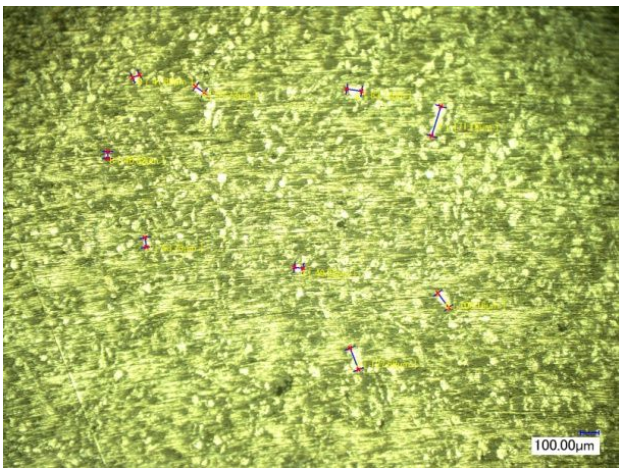

Fig. 2. Sample 2. The average particle size 44 µm

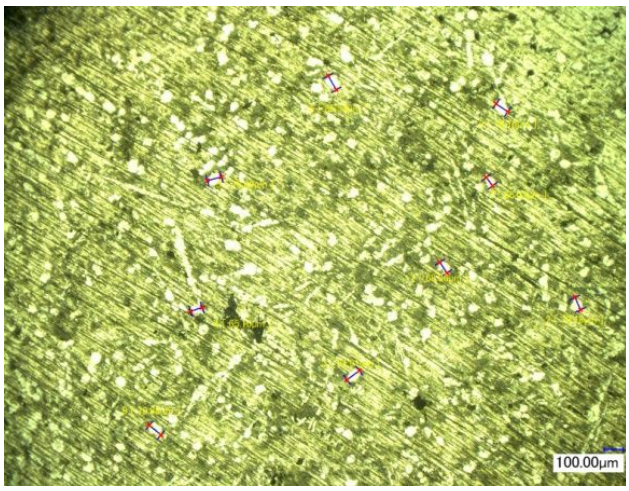

Fig. 3. Sample 3. The average particle size 54 µm.

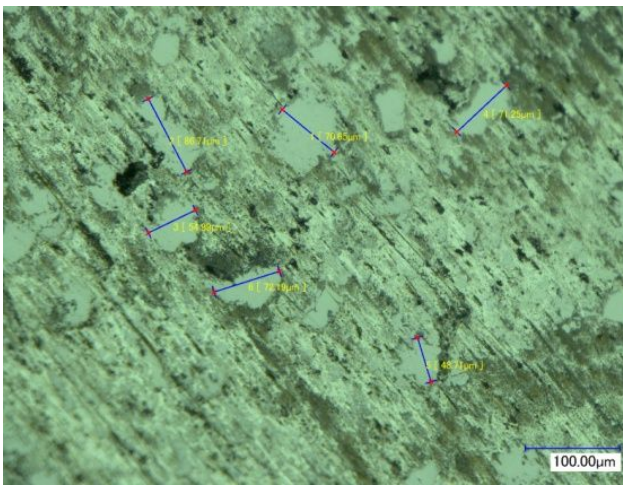

Fig. 4. Sample 4. The average particle size 63 µm

The hardness of the obtained material in the annealed condition when tested on the Brinell hardness is about 25-28 HB, but the microhardness of the ceramic elements of the inclusions is greater than 70 HRC, which substantially increases the mechanical strength and abrasion resistance.

References:

1. Chernyshov EA, Romanov A.D. High-aluminized fuel based on aluminum and its application / / Engineering - from theory to practice. 2013. No. 24. pp. 69-73.

2. Mylnikov V.V., Abrosimov A.A., Romanov I.D., Romanov A.D. Analysis of materials and their properties used for means of individual armor protection. // Successes of modern natural science. 2014. No. 9-2. pp. 143-147.

3. Chernyshov Y.A., Mylnikov V.V., Romanov D.A., Romanova E.A. Development of technology for aluminating disperse-filled molded composite material with control of dimensions of the phase reinforcement // VI international conference "Deformation and fracture of materials and nanomaterials".

Moscow. November 10-13, 2015/ The Collection of materials. – Moscow: IMET RAS, 2015 P. 667-669.

4. Romanov A.D., Chernyshov Y.A., Mylnikov V.V., Romanova E.A. Development of technology for obtaining composite material based on aluminum // International journal of applied and fundamental research. 2014. No. 12-2. pp. 176-179.

5. Chernyshov E.A., Mylnikov V.V., Romanov A.D., Romanova E.A. Development of a method to manufacture cast multicomponent systems with a given size and distribution of nonmetallic reinforcing particles // Modern problems of science and education. 2014. No. 6. p. 324.

6. Chernyshov E.A., Investigation of the microstructure aluminating particulate-filled cast composite material obtained by internal oxidation / E. A. Chernyshov, S.Z. Lonchakov, A.D. Romanov, V.V. Mylnikov, E.A. Romanova // Advanced materials. 2016. No. 9. pp. 78-83.