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Composite material based on synthesized zirconium oxide nanopowders with enhanced mechanical properties

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The widespread appliance of nanopowders based on zirconium dioxide in various fields, where characteristics such as high density, hardness, wear resistance, and bending strength are required, pose the problem of developing zirconium nanopowders with enhanced mechanical properties. Zirconium oxide is characterized by its polymorphic transformations, which in some cases makes it possible to increase the strength and crack resistance of the composite material. There are various methods for producing zirconium oxide nanopowders and, depending on the method for obtaining the initial powders, the properties of the resulting material change accordingly.

The method of obtaining nanoparticles based on zirconium dioxide from fluoride solutions was investigated in this work. We used hydrofluoric acid HF, concentrated nitric acid HNO_3, aqueous ammonia NH4OH, metallic zirconium, polyvinyl alcohol from Reakhim. Distilled water was used to prepare solutions. The particle surface morphology was examined using a JSM-6390LV scanning microscope (SEM).

During deposition from a fluoride solution, precursor particles are formed to obtain zirconium dioxide, which is formed mainly by small spherical particles less than 100 nm in size (Fig. 1a).

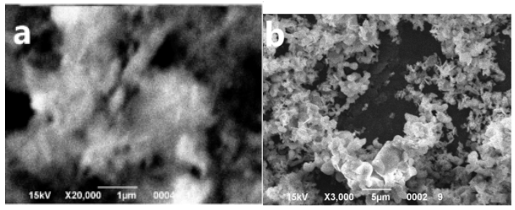

Fig. 1. Micrograph of particles obtained during thermal heating of the precursor deposited at 20°C without additive at 25°C (a) and micrograph of ZrO_2 particles obtained after annealing at 800°C with the addition of polyvinyl alcohol at the ratio m (Zr): m (PVC): - 1: 0.1 (b).

Using an additive of polyvinyl alcohol in a synthetic mixture leads to the formation of particles in the form of thin plates, the size of which is directly proportional to the concentration of the additive (Fig. 1b).

It is known that compaction of ZrO_2-WC composites by hot pressing makes it possible to obtain high-density specimens with a homogeneous microstructure with high mechanical characteristics [1]. The method of electroconsolidation was used to form pressed elements from ZrO_2-Y_2O_3 nanopowders.

1. E Gevorkyan, O Melnik, V Chishkala 'The obtaining of high-density specimens and analysis of mechanical strength characteristics of a composite based on ZrO 2-WC nanopowders', Nanoscale research letters, no. 355,July. 2014.