OBTAINING THE ULTRADISPERSE MATERIAL OF THE Al-Mg-O SYSTEM BY PLASMA DYNAMIC METHOD

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Nanomaterials, in particular metal oxides, have a wide range of applications. Prospects for use of such materials are associated with their unique features in the ultrafine state. Aluminum oxide is a wide-gap dielectric with high wear resistance, mechanical and chemical resistance, which is used in medicine, optics and various technical fields [1, 2]. It is known that there is a possibility of improving the characteristics and improving the functional properties of the material due to the introduction of a small amount of the $MgAl_2O_4$ spinel phase into its composition [3].

To date, there are many methods for producing nanosized aluminum oxide, for example, gas-phase method, electric explosion method of conductors, or sol-gel method [4-6]. Of course, these methods have advantages and disadvantages. The disadvantages include unsatisfactory dispersion of the product and high duration and multi-stage nature of the material production process.

The method of plasma dynamic synthesis developed at the Tomsk Polytechnic University is devoid of the above-noted drawbacks and can be considered as an alternative method for producing nano-dispersed aluminum oxide. This method is based on the use of high-current high-voltage coaxial magnetoplasma accelerator of the erosion type with an aluminum accelerator channel. The main advantage of the method is its speed – the synthesis time takes less than 1 ms [7]. At the same time, the resulting products are distinguished by their high dispersion. The simplicity of the method lies in the fact that, using a simple aluminum alloy tube containing about 7% magnesium as a barrel, and when the gaseous precursor oxygen is pumped into the reactor chamber, it is possible to obtain unique aluminum oxide and spinel phases. Synthesis of aluminum oxide was carried out due to erosion of the aluminum barrel. When the arc flows through the acceleration channel, the base material, aluminum, is produced, after which it is carried into the chamber, where it enters into a plasma-chemical reaction with oxygen, forming the desired product. To obtain purer product of plasma dynamic synthesis, it was proposed to use a system with the separation of the synthesized product into a large and small fraction.

The paper shows experimentally the possibility of producing aluminum oxide and spinel in a system based on the use of a pulsed high-current coaxial magnetoplasma accelerator of the erosion type. The average particle size in the product varies from 50 nm to 250 nm. It should be noted that the installation allows you to change the ratio of Al_2O_3 to $MgAl_2O_4$. In the future we plan to use this material to obtain bulk ceramic samples.

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