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NON-METALLIC ULTRA-DISPERSED POWDER OBTAINED IN THERMAL PLASMA*

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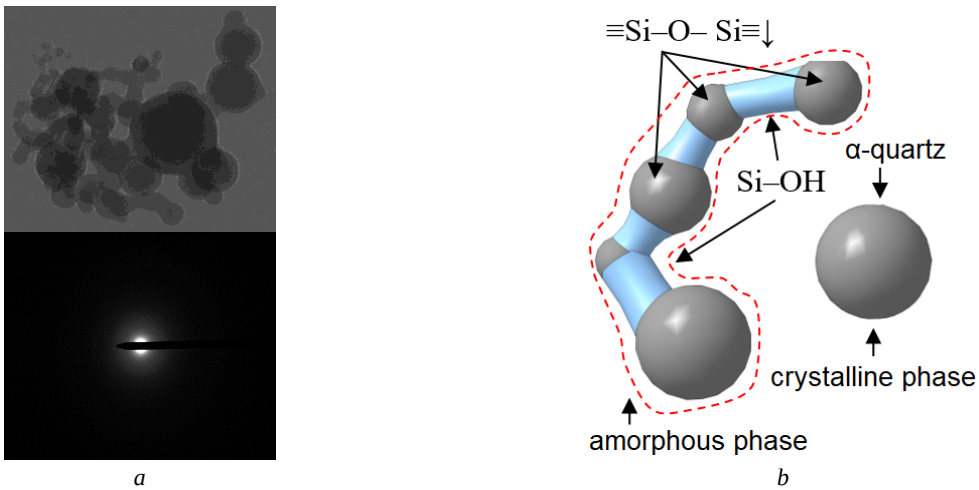
The synthesis and study of nanosized refractory oxide powders today is an urgent problem in predicting the characteristics of materials obtained on their basis. To date, the most capacious market for the production of nanosized powder is the production of silicon dioxide SiO_2. This nanosized powder has found its application in the production of structural materials [1] and coatings [2]. A wide material base for the production of nano-sized SiO_2 can be natural raw materials enriched with silicon dioxide over 75 wt. %, for example quartz sands and concentrates based on it.

To obtain oxide nanopowder SiO_2, quartz sand (QS) was used - Tugan deposit, Tomsk, Russia. Silicon dioxide content ~ 97 wt. %. The synthesis of nanopowder was carried out in a plasma-chemical reactor [3, 4], including: an electric-arc plasmatron (cathode) with an outlet nozzle section of 8 mm; water-cooled cylindrical chamber (h = 150 mm, r = 75 mm), at the base of which a graphite anode is installed; system for supplying a plasma-forming gas (compressed air) and cooling liquid to heat-stressed elements; power supply with adjustable amperage from 5 to 160 A. The operating parameters during the experiments corresponded to: current strength 150 A, voltage 110 V, plasma-forming gas flow rate 20 l/min, thermal efficiency 78%. The calculated mass-average temperature of the generated plasma reaches 5400 K.

According to TEM data (electron microscope Philips CM 30), it was found that the obtained SiO_2 nanopowder in the initial state mainly consists of spherical particles of polydisperse composition (Fig. 2).



a *b*

Fig.1. Morphology of ultrafine SiO2 particles: a - TEM images; b – physical model

The particle diameter is in the range from 10 to 150 nm, while there are single particles with a diameter of 500 nm. Of the morphological features, we note the presence of rounded-oval, ellipsoidal and welded particles, while there are no pronounced contact zones (see Fig. 2). These features are typical for particles less than 80 nm. Particles ~ 500 nm in diameter are crystallized and correspond to high-temperature α-quartz.

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