ELECTRIC ARC SYNTHESIS OF TITANIUM CARBIDE PARTICLES

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The carbon arc is used to synthesize a wide range of nanomaterials. The discovery of such carbon nanostructures as fullerenes and carbon nanotubes in the reaction products (soot) brought the fame to the reactor based on the graphite arc. Another important application of the electric arc discharge is the synthesis of various metal-carbon composite materials. In this case, additions of various elements with the pressure of saturated vapors not lower than that of graphite are introduced into the material of electrodes (or one of the electrodes). The reaction products can be metallic nanoparticles in a carbon matrix, particles of metal oxides and carbides.

In this research, the materials formed in the gas phase were studied at joint electric arc spraying of titanium-graphite (Ti-C) and TiC-G rods. The Ti-C nanostructured material is synthesized by a DC plasma-arc setup. The reactor is a vacuum chamber, which is pumped out and then filled with helium to the working pressure. In the reactor, there are two electrodes, and the distance between them can vary. A DC arc discharge glows between them. The cathode is a graphite tablet with the diameter of 20 mm; the anode is a rod with the diameter of 8 mm and length of 70 mm. A water-cooled removable screen is mounted around the electrodes at the distance of 5 cm to collect the synthesis products. Under the conditions of the present experiments, the interelectrode distance is maintained to achieve the arc voltage of 20 V; the discharge current of 125 and 150 A was set. The anode is a graphite rod with an aperture along the axis, filled with silicon-graphite powder in a predetermined ratio. The rods were made of carbon with the density of 1.82 g/cm3 and purity of 99.99. The powder of pure titanium and titanium carbide was used as a titanium additive. The molar fraction of metal in the sprayed electrode was 6.4% and 20%. The synthesized material was annealed in air at the temperatures of up to 950°C. The materials were analyzed by transmission electron microscopy (JEOL - 2010).

Due to the works performed, the experimental data on the synthesis of titanium-carbon composites under various discharge conditions were obtained. The shape, size and phase composition of titanium particles in the carbon matrix were investigated. It is shown that when the carbon matrix is removed, the nanoparticles are sintered and oxide particles larger than 100 nm are formed.

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