Nanocomposites and nanomaterials

High-Themperature Electrochemical Synthesis of Nanopowders of Tungsten Carbide in Ionic Melts

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To investigate the conditions of the tungsten carbide synthesis, the following electrolyte was selected: Na_2WO_4-Li_2WO_4-Li_2CO_3. At a temperature of 800 °C and higher, lithium carbonate simultaneously evaporates (in the form of Li_2CO_3) and decomposes with the release of CO_2 until some steady state is attained. The latter steady state is established after 2-3 h under heating conditions at T = 800-900 °C and after 30-35 h at T = 500 °C. The maximum loss of the electrolyte mass during the heating is at most 4.5% (by weight).

The melt composition variations lead to qualitative variations in the phase composition of tungsten carbide. It should be noted that CO_2 concentration in the melt in the graphite crucible is significantly higher than in the platinum beaker due to thermal oxidation of the graphite to CO_2. With anode current density $1 \cdot 10^{-2}$ A/cm^2, it is possible to achieve stabilization of the CO_2 content in the melt and, consequently, that of the Li_2CO_3 content as well. Through use of the selected electrolysis parameters it is possible to maintain a constant flux of electrolytic reducing components of the synthesis, a necessary condition for sustaining the lengthy process of producing tungsten carbide.

The adjusting addition agent needed to achieve an optimum electrolysis regime (T - 850 °C, i_c = 1.5 A/cm^2, i_a = 0.1 A/cm^2, electrolysis time τ = 1 h) is a mixture of the following composition: Li_2WO_4, 86.45%; Li_2CO_3, 13.55%, and the rest of the initial electrolyte. The necessary quantity of the mixture of lithium tungstate and lithium carbonate introduced into the electrolyte in the indicated ratio corresponds to the mass of the carbide salt "bulb" removed from the melt.