Laws of Combustion and Phase Formation in WO_3-Mg-C-Na_2CO_3 system

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Abstract

Magnesium reduction method is widely used to synthesized transition metals carbide by combustion synthesis method. According to literature data many types of carbides were successfully prepared by this way(TiC, HfC, ZrC) [1]. Despite of it, evidence success on the synthesis of single phase WC from WO_3 by magnesiumwasn't achieved. As a rule the combustion of WO_3-Mg-C mixture always lead to the multiphase product formation: W, W_2C, WC, Na_2WO_4. The main problem of that is low diffusion coefficient of carbon in tungsten (Do= 0.00891 cm^2/sec).

In the present work a new technique to synthesized WC from WO_3 by Mg reduction method is developed. The technique involves the combustion of WO_3-Mg-C system in the presence of alkali metal carbonate. The processing parameters investigated include combustion temperature, the concentration of raw materials and the sample diameter. The final products are preliminary washed and examined by XRD and SEM analysis. It was established that at the defined concentration of raw materials the combustion process in this system lead to the single phase WC formation at the temperature 1200-1500 °C. Generally the chemical reaction in this system can be described by the following equation:

$$WO_3+Mg+C+Na_2CO_3 \rightarrow Na_2WO_4+MgO+WC+CO$$

According to the given schema WO_3 partially transforms to sodium tungstate (Na_2WO_4) which is soluble in the water and has low melting point (790°C). Experimental data obtained conform that due to the melting of Na_2WO_4 in the combustion wave became possible the complete carburization of tungsten in such low temperature within very short time. The yield of as synthesized WC powder is about 60-70 % and the size of particles less than 1mm.