Thermodynamic Estimation of Tungesten Carbide Synthesis by Thermal Plasma

Obryvalin M V[1,@] **and Subbotin D I**[1,2]

[1] Saint-Petersburg State Technological Institute (Technical University), Moskovsky Avenue 26, Saint-Petersburg 190013, Russia
[2] Institute for Electrophysics and Electrical Power of the Russian Academy of Sciences, Dvortsovaya Naberezhnaya 18, Saint-Petersburg 191186, Russia

[@] MaximVObryvalin@yandex.com

Unique important physical and chemical properties of tungsten carbide: high hardness and melting point chemical resistance explain the compound's usage in toolmaking, material science and jewelry. Demand for tungsten carbide calls for benefitial large-scale ecological ways of producing it. One method is to use thermal plasma. A mixture of CH_4, Ar with ratio of 1: 5 was chosen for the purpose of generating said plasma gas. This ratio was chosen due to the required working conditions of multigas high-voltage AC plasma torch. The variables: Reactor's temperature(K) and Flow rate of gas mixture(kg/kg_{WO3}) were estimated using the mathematical iteration method. Specific energy input of the results were then calculated. The estimated optimal temperature in reactor is 2890 K with the gas mixture flow rate being 2.0 kg per 1.0 kg of WO_3, that is the point with the highest tungsten carbide yield without graphite being formed. Specific energy input for those conditions is 1.24 MJ/kg or 0.344 kWh/kg. Plasma enthalpy is calculated to be 2.95 MJ/kg.