

PREPARATION OF VANADIUM CARBIDE BY THE SHS METHOD WITH A REDUCTION STAGE

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Cemented carbides WC-Co are commercially one of the oldest and most successful powder metallurgy products. The properties of these materials are determined by the properties of the components, in particular, the grain size of the carbide phase [1, 2]. Fine VC powders are of interest as additives to sintered WC-Co cemented carbides as an inhibitor of WC grain growth [3, 4]. Carbide powders in [4] were synthesized by a method consisting of carbothermic reduction of a mixture of oxides at 1050 °C and a subsequent carburization process at 1300 °C in a hydrogen atmosphere. The reaction mixture was heated in a furnace.

We synthesized vanadium carbide powders using the SHS method with the stage of calcium-thermal reduction. The process occurred according to the approximate scheme $V_2O_5 + 5Ca + 2C \rightarrow 2VC + 5CaO$ in combustion mode, which did not require furnace heating. The following starting reagents were used: calcium granules with a diameter of 0.5-2 mm produced by the Chepetsky Mechanical Plant, argon gas of high purity, vanadium (V) oxide (analytical grade) and lamp carbon black. The initial mixtures were prepared with a 20% excess of calcium. The starting mixture was poured into a paper cup with a diameter of 23 mm, which was placed in a sealed reactor. The reactor was filled with argon to a pressure of 1 MPa. Combustion was initiated with a short pulse of an electric coil. The cooled product was washed from CaO with a weak solution of hydrochloric acid. An X-ray image of the product is shown in Figure 1.

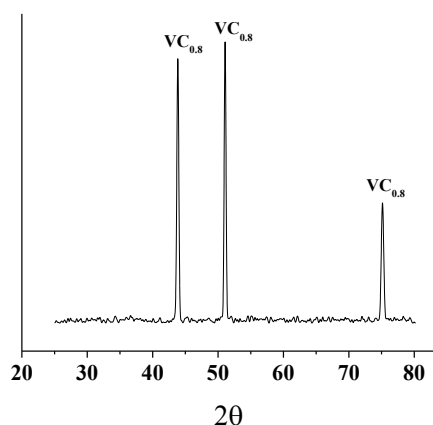


Fig.1. X-ray diffraction pattern of the final reaction product after acid treatment.

The results obtained showed that the SHS method with a reduction stage can produce almost single-phase vanadium carbide powder.

REFERENCES

1. S Farag, I Konyashin, B Ries, "The influence of grain growth inhibitors on the microstructure and properties of submicron, ultrafine and nano-structured hardmetals – A review". *Int. J. Refract. Metals Hard Mater.* 2018, vol. 77, pp. 12-30. <https://doi.org/10.1016/j.ijrmhm.2018.07.003>
2. CR Weinberger, GB Thompson, "Review of phase stability in the group IVB and VB transition-metal carbides". *J Am Ceram Soc.* 2018, vol. 101, no. 10, pp. 4401–4424. <https://doi.org/10.1111/jace.15768>
3. B Wang, Z Wang, Z Yin, J Yuan, J Jia, "Preparation and properties of the VC/Cr3C2/TaC doped ultrafine WC-Co tool material by spark plasma sintering". *J. Alloys Compd.* 2020, vol. 816, 152598. <https://doi.org/10.1016/j.jallcom.2019.152598>
4. XH Yang, KF Wang, GH Zhang, KC Chou, "WC-VC/Cr3C2 composite powders prepared by a carbothermic reduction-carburization process". *Int. J. Refract. Metals Hard Mater.* 2022, vol. 109, 77, 105982. <https://doi.org/10.1016/j.ijrmhm.2022.105982>