

OBTAINING OF VANADIUM NITRIDES DURING THE COMBUSTION OF VANADIUM OXIDE WITH CALCIUM AND CALCIUM NITRIDE IN NITROGEN¹

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Calciothermic reduction of metal oxides is accompanied by the high amount of heat release, which leads to the significant heating of a green mixture. A relatively low melting temperature of calcium (838 °C) results in the formation of liquid with a high chemical activity, and therefore, the choice of the reactor material becomes a serious problem. The known method for the hydride-calcium obtaining of metal powders [1] reduces the temperature of reduction reaction to a relatively low temperature (1200 °C) due to adding pure metal powders to a green mixture.

Such temperatures do not allow synthesis to be conducted in the self-propagating mode. There is a need in the heating of reaction masses, which leads to high energy costs. Partial replacement of calcium by calcium nitride, with the appropriate amount of nitride, allows the reduction reaction to be conducted in the self-propagating mode without external supply of heat and the formation of a large amount of flowing reaction masses at temperatures up to 2500 °C. During synthesis in the combustion mode, the reaction time decreases from several hours to several minutes.

Vanadium nitride was obtained from vanadium oxide during the combustion of V_2O_5 , Ca, Ca_3N_2 mixtures under the nitrogen atmosphere.

The calculated values of the adiabatic reaction temperature are shown in Fig. 1.

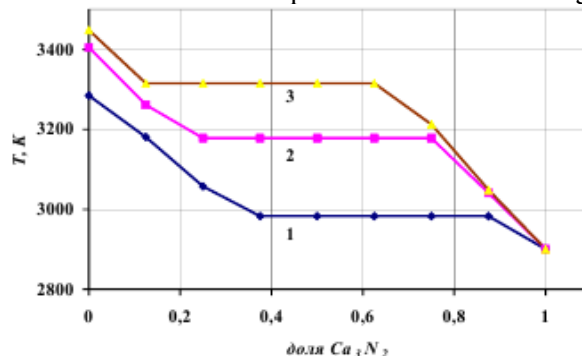


Fig. 1. Adiabatic combustion temperature for the stoichiometric composition « V_2O_5 - Ca - Ca_3N_2 - nitrogen» versus the amount of Ca_3N_2 replacing metallic calcium. Nitrogen pressure: (1) - 1; (2) - 3, (3) - 6 MPa

Powder mixtures were burned in paper cylindrical cups with a diameter of 23 mm in a constant-volume bomb. The preservation of the sample shape was observed when more than 70% of metallic Ca was replaced by Ca_3N_2 nitride obtained by the combustion of Ca powder in nitrogen [2]. The measured combustion temperatures were lower than the calculated ones, which can be explained by the heat removal to the environment. After acid removal of calcium compounds, the main phases in the products are vanadium nitrides.

REFERENCES

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- [2] Avramchik A.N., Chukhlomina L.N., Maksimov Yu.M., Bulgar K.A. Bulletin of Tomsk Polytechnic University.- 2013.- V.322. - No.3.- P.26-28.

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