THERMOSTABILITY ON AIR OF SOME POWDERY CARBIDES

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The powdery carbides of metals have high hardness, therefore can be used as abrasives. In this connection the purpose of work was research of oxidization of carbides of titan, zirconium and hafnium in the isothermal and unisothermal regimens on derivatograph Q-1500.

For researches used TiC, ZrC, HfC, SiC, B_4C of mark «Pure» (99 %). The sizes of the studied powders set with granulometric analysis. Treatment of data, got from granulometric analysis, let to define fractious composition of the studied systems. Appeared, that in all sprinkles of snow particles prevail by the size of 5-10 micrometers. Exactness of determining size of particles is 2%. In this work the process of oxidization of powders on air was explored in the isothermal mode in the interval of temperatures 700 -1000 °C (time of self-control at every temperature 30, 60 min) and in unisothermal terms at the programmed heating of standards on derivatograph Q-1500 with the simultaneous conducting of differential-thermal analysis. We defined stability to oxidization on air of the studied samples after the degrees of their transformation, using a formula:

$$\alpha = \Delta m_F / \Delta m_{Theor}, \qquad (1)$$

where Δm_F is an factual change of mass of matter and Δm_{Theor} is a change of mass of matter, if it would be oxidized fully.

Equalities on which the processes of oxidization of the investigated matters run and formulas after which Δm_{Theor} are obtained, and heat effects, calculated by the Gess law and from DTA-curves are given in table 1.

Oxidization of powders was studied at a speed of heating 5 and 10 K/min. It is established that the studied powders TiC, ZrC, HfC, B_4C begin to interact with oxygen of air already at 400, 600, 530, 510°C, and the increase of temperature results increase of the degrees of their transformation. Degrees of oxidization (α) of TiC, ZrC, HfC, B_4C is at 40, 40, 70 and 60 % accordingly. It testifies about their very high thermal stability.

Composition of products of oxidization was determined with X-ray-graphical method on diffractometer DRON-3. It is established, that at oxidization of TiC, ZrC, HfC, B_4C formed oxides -TiO_2, ZrO_2, HfO_2, B_2O_3.

By DTA-curves we obtained the thermal effects of processes of studied metal carbides oxidization. In obedience to our derivatographical investigations, processes observed at oxidizations of TiB_2, ZrB_2, HfB_2, B_4C — large exothermic. Using the areas of peaks of DTA-curves, we defined thermal effects which was observed at oxidization 1 begging TiB_2, ZrB_2, HfB_2, B_4C on a formula

$$\Delta H = \frac{k \cdot S}{n_i \cdot \alpha}, \qquad (2)$$

where n_i is an quantity of mol of pure matter which was oxidized, k – proportionality coefficient, S – area of peak. Coefficient of proportionality between a thermal effect and area of peak on DTA-curve is determined by known enthalpy of melting and the DTA-curves, obtained at derivatographical investigations KCl and Na_2WO_4. The expected values of coefficients of proportion are evened 8,8 and 12 unit. at the sensitiveness of DTA 250 and 500, accordingly. Taking into account the degree of transformation of investigations matters, we calculated a complete heat which allocated in the studied processes. Obtained thermal effects are given in table.

Table 1. A theoretical change of the masses and thermal effects, calculated by Gess law (a) and from DTA-curve (b) (kJ/mol).

Carbide	Δm_{Theor}	-ΔH, kJ/mol	
		(a)	(b)
TiC	0,3336 m_s	1128,6	385
ZrC	0,1936 m_s	1286,6	528
HfC	0,1049 m_s	1292	711
SiC	0,4985 m_s	1235,7	0
B_4C	1,5201 m_s	2839,5	955

It was found that the most thermally stable is SiC, despite the fact that the thermal effect of oxidation is not less than the other studied carbides. High thermal stability of SiC can be attributed to forming of protective thin SiO_2 films.