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EXPERIMENTAL STUDY OF THE THERMAL STABILITY OF MATERIALS IN HIGH TEMPERATURE OXYGEN-CONTAINING MEDIA

Y. Ye. Abaltusov, A. R. Bagramyan, A. M. Grishin and V. I. Yukhvid

Translation of "Eksperimental'noye issledovaniye teplostoykosti materialov v vysokotemperaturnykh kislorodsoderzhashchikh sredakh", IN: Fizika Goreniya i Vzryva, vol. 17, Jan-Feb. 1981, pages 147-148, (A81-28022).

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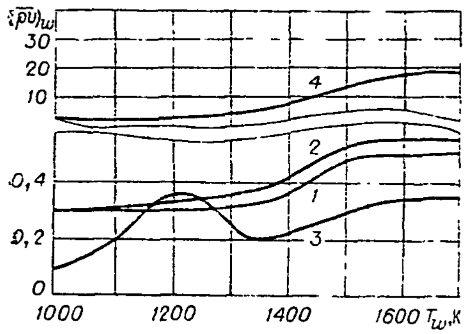
Recently, the problem of the thermal protection of hypersonic devices has become very pressing [1,2]. In order to determine the most effective materials for systems of thermal protection for such devices, an experimental study has been made of the interaction of several materials (graphites, of the brands ARV, PG-50 and V-1, tungsten and chromium carbide) with a high temperature medium containing oxygen.

The study used cast chromium carbide with a mass content of oxygen $C_{связ}=13.1\%$, obtained by the SVS** method [3-5]. The total content of the (Al_2O_3, $C_{своб}$) admixtures did not exceed 1%. The initial components for the synthesis of chromium carbide were a powder of chromium anhydride CrO_3 (GOST 3776-6), aluminum (АСД1) and carbon black (ПМ-15Т).

Comparative tests of the semi-spherical models made of the materials to be studied were carried out in a stream of an acetylene oxygen gas generator with the parameters $T_e=3000$ K, $u_e=40$ м/с, $C_e=0.2$, where T_e, u_e are the temperature and velocity of the flow on the stream axis, C_e--concentration of oxygen. The required volume of information obtained during the tests was provided by measuring the temperature of the surface T_w as a function of the time t, and determining the velocity of the mass removal from the surface of the samples $(\rho v)_w$ as a function of T_w, using the method described in [6]. In order to identify the processes of heat and mass exchange occurring on the surface, dimensionless measurements were performed of the velocity of the mass removal:

*Numbers in margin indicate pagination of foreign text.

**Expansion unknown.



Relative effectiveness of the materials studied. 1,2--PG-50, ARV graphite, respectively; 3--tungsten; 4--chromium carbide

$(\bar{\rho v})_w = \frac{(\rho v)^*_w}{(\rho v)_w}$, where $(\rho v)^*_w$ --velocity of mass removal from the surface of the reference sample (B-1); $(\rho v)_w$ --velocity of mass removal from the surface of the sample being studied. /148

The results are shown in the figure as a function of the surface temperature T_w. The higher the values of $(\bar{\rho v})_w$, the more effective is the material from the viewpoint of heat resistance. The figure graphically shows the advantage of chromium carbide as compared with tungsten and graphite. The results of photographing and making a detailed study of the structure of the sample surfaces showed that on the surface of the models made of chromium carbide, a protective film of high melting Cr_2O_3 oxide is formed, whose melting point is higher than the melting point of chromium. With regard to the samples of tungsten and graphite, they oxidize intensively at temperatures which are far below the melting point. Thus, chromium carbide is the most effective of the materials examined for thermal protection in high temperature media containing oxygen in a temperature range of $300 < \bar{T}_w < 1800$ K and an oxidant concentration of $0,1 < C_{O_2} < 0,3$ in a gas flow.

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16. Abstract

An experimental study is made of the interaction of several materials with a high temperature medium containing oxygen. The temperature of the surface was measured as a function of time. It is found that the higher the velocity of mass removal from the surface, the more effective is the material from the viewpoint of heat resistance.

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