COMBUSTION SYNTHESIS OF SIALON CERAMIC IN FORCED OSCILLATION MODE[1]

A. MAZNOY, A. KIRDYASHKIN.

Tomsk Scientific Center SB RAS, 10/4 Akademicheskii pr., Tomsk, 634055, Russia, maznoy_a@mail.ru, +79234124765

Organization the combustion synthesis of producing porous oxynitrides in forced filtration mode allows one to obtain porous ceramics at a nitrogen pressure less than 1 MPa [1]. In order to provide full conversion of the reagents into the ceramic during CS it is necessary to maintain high specific surface of powdered reagents. Therefore, melting and coalescence of the condensed phases in combustion wave zone should be avoided. Maximum combustion temperature control might be achieved by portion supply of the reacting gas.

Filtration combustion synthesis was investigated using a powder mixture, which was normalized to yield β-sialon $Si_2Al_4O_4N_4$. Structure formation in the porous reaction samples was carried out as described in [1]. Samples with following parameters was used: cylindrical shape (d = 40 mm, h = 40 mm), mass of samples m_0 = 100 g, $Si_2Al_4O_4N_4$ dilution rate φ = 0.45, porosity 65%. For combustion synthesis, an experimental setup schematically shown in [1] was used. Oscillation supply of fuel was carried out by means of the special valve intercepting the gas inlet into the reactor at a given frequency γ, which is defined as the number of "open/close" cycles per minute. Combustion synthesis was performed with following conditions: excess pressure in reaction chamber P_0 = 600-900 kPa, initial nitrogen mass flow Q_0 = 0.26 g/s, γ = 5 min^{-1}, filtration in coflowing configuration. During the synthesis the pressure in the reaction chamber cyclically oscillated from P_{min} = 600 kPa to P_{max} = 870 kPa. The combustion synthesis parameters (maximum temperature in the combustion wave T_m, combustion rate U_C, the conversion rate ν) obtained in the above-mentioned experiment, as well as in experiments without forced oscillation with fixed values of pressure corresponding to P_{max} = 870 kPa and P_{min} = 600 kPa, are presented in Table 1. It was found out that in forced oscillation mode the maximum temperature in combustion wave zone reduces and conversion rate of the products increases.

Table 1. Macrokinetic parameters of the combustion synthesis under various conditions

Conditions	**T_m [ºC]**	**U_C [mm/s]**	**ν**
Oscillations γ = 5 min^{-1}. P_{max} = 870 kPa. P_{min} = 600 kPa	1500	0.51	0.97
No oscillations, P = 870 kPa	2050	0.50	0.93
No oscillations, P = 600 kPa	1890	0.41	0.90

For the observed combustion rates the minimum required nitrogen intake into the reaction zone should be Q_{min} > 0.075 g/s. Figure 1 shows the dependence of the mass flow through the reaction chamber. When the valve overlaps the flowing stream, the gas flow through the reaction chamber $m(t)$ takes negative values. It means that the gas flows out of the reactor. Apparently, the nitriding reaction in these moments is suppressed. Optimal conditions for the synthesis occur only in the periods when the valve is in the open position. Thus, reduction of the maximum temperature observed in experiments with forced oscillation of nitrogen supply is achieved due to kinetic limitations of the combustion. The combustion mode under discussion makes it possible to decrease the content of thermal diluents required for full conversion of the mixture into the products.

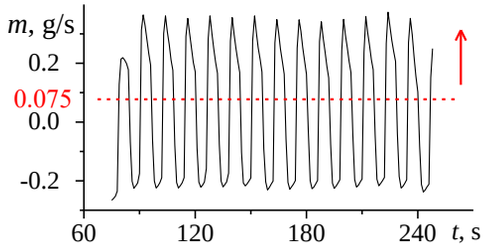

Fig. 1. Experimental dependences of the net mass flow through the reaction chamber

REFERENCES

[1] *Maznoy A, Kirdyashkin A, Gabbasov R.. // International Journal of Heat and Mass Transfer. – 2016. – 95. – 264-271.*

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