MODIFYING EFFECT OF ROTATIONAL FORCES ON THE MECHANISM OF THE PROCESSES OF THE SELF-PROPAGATING HIGH-TEMPERATURE SYNTHESIS IN METALLOTHERMAL SYSTEMS DURING THE SYNTHESIS OF INORGANIC MATERIALS

G. I. Ksandopulo

Institute of Problems in Combustion of the Ministry of Education and Science of the Republic of Kazakhstan, 172 Bogenbai Batyr Str., Almaty 050012, Kazakhstan

Abstract: The mechanism of the modifying effect of rotational forces on the structure of the SHS-wave (SHS — self-propagating high-temperature synthesis) front in a cylindrical reactor with a compressed aluminothermic mixture rotating around a vertical axis is presented. It is shown that under the action of centrifugal forces, the particles of the reduced metal produced in the reaction zone of the SHS-wave move to the region ahead of the wave front and initiate new ignition sites in the fresh mixture, thus increasing the propagation velocity of the SHS-wave. This process opens up the possibilities for the synthesis of new nonequilibrium inorganic compounds with high temperature stability and a set of useful properties. As an example, the modifying effect of the addition of inorganic radicals (0.036% $Al_{20}B_4O_{36}$) on the crystallization of the silumin melt with a significant decrease in the size of crystals in the cooled melt is demonstrated.

Keywords: SHS; aluminothermy; centrifugal force; ignition sites; modifying effect

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Figure Captions

Figure 1 Schematic of a centrifugal installation for obtaining an adiabatic SHS-wave: *1*, *2*, *3* — rotating reactors; *4* and *5* — front and back covers of the reactors; *6* — openings for gas exhaust in the front cover; *7* — steel casing; *8* — quartz tube; *9* — ignition point; *10* — SHS-wave; and *11* — adiabatic combustion wave

Figure 2 Rotating reactor for the synthesis of materials; *1* — initiation (ignition); *2* — primary combustion front; *3* — the birth of adiabatic wave; and *4* — metal particles in the fresh reactive mixture

Figure 3 Metallography of silumin ingots: (*a*) modified and (*b*) unmodified

Table Caption

Dependences of the kinetic energy and enthalpy on the radius of the tungsten particle r and the radius-vector R of the reactor

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Contributor

Ksandopulo Georgy I. (b. 1929) — Doctor of Science in chemistry, professor, Honorary Director of the Institute of Problems in Combustion of the Ministry of Education and Science of the Republic of Kazakhstan, 172 Bogenbai Batyr Str., Almaty 050012, Kazakhstan; ksand@inbox.ru