IGNITION OF GAS MIXTURE BY COMBUSTION PRODUCTS OF THERMITE COMPOSITION Al/CuO

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Abstract: The paper presents new experimental results on the dynamics of the cloud of explosive combustion products of the mechanoactivated composition Al/CuO. The parameters of the cloud of combustion products depending on the mass of the mixture were determined using the methods of high-speed photoregistration, pyrometric measurements, and photovoltaic and electrocontact sensors. Various methods of ignition and formation of the product flow are considered. Optimal conditions for the formation of a torch for ignition of combustible gas–air mixtures have been determined.

Keywords: aluminum; copper oxide; mechanical activation; explosive combustion; ignition; combustible gas

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Figure Captions

Figure 1 Schemes of experimental assemblies for the formation of a thermite mixture combustion torch: *1* — a weighed portion of the thermite mixture; *2* — point of initiation; *3* — cloud of products; *4* — electrical contact sensor; *5* — channel; *6* — target; M_{cm} — mass of the sample; E_{init} — spark energy; d_{channel} — channel diameter; L_{channel} — channel length; l_{init} — distance from the initiation point to the open end of the channel; and L_{mix} — length of the mixture charge in the channel

Figure 2 A typical photograph (*a*) and graphical representation of the expansion dynamics of the luminous area during burning of a mixture sample in free space: *1* — 0.06 g; *2* — 0.25; *3* — 0.75, and *4* — 1.5 g (*b*)

Figure 3 Expansion dynamics of the luminous area in time: *1* — 0.06 g; *2* — 0.25; *3* — 0.75, and *4* — 1.5 g

Figure 4 Rate of expansion of the luminous area depending on the weight of the sample: *1* — $dV/dt = -0{,}6M^2 + 2{,}1M$; and *2* — $dV/dt = 1{,}5M$

Figure 5 A typical photograph of a quasi-cylindrical torch of mixture combustion (0.06 g). The mixture sample was placed in a shell with a depth of 2 mm with one free surface (*a*); and dynamics of linear expansion (*b*) and volume increase (*c*) of the luminous area at different energies of electrospark initiation: *1* — 120 mJ; and *2* — 20 mJ

Figure 6 Dynamics of expansion of the luminous area (*a*) and the increase in the torch volume (*b*) depending on the location of initiation point along the channel depth

Figure 7 The breakdown-burning traces of the flow of reacting mixture particles on a 0.3-millimeter thick polymer target

Figure 8 Photographs of ignition process of propane–butane gas mixture: (*a*) the initial stage of the initiation process in the chamber; and (*b*) radiation recorded outside the chamber with the release and afterburning of propane–butane–air mixture outside the chamber

Table Caption

The results for the dynamics of the flame region for various schemes of mixture location

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