DEVELOPMENT OF THE METHOD OF MECHANICAL ACTIVATION OF THERMITE MIXTURES

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Abstract: The process of mechanical activation of thermite compositions based on mixtures of aluminum powders with solid oxidizers is analyzed. New data on changes in the phase composition during the activation of aluminum in a mixture with copper oxide and optimal conditions for the production of mechanically activated composites in a planetary mill are presented. Fast-burning compositions have been obtained that are comparable to compositions based on nanosized components in terms of combustion rates and laser initiation parameters.

Keywords: mechanical activation; nanothermites; aluminum; copper oxide; ignition temperature; burning rate

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Figure Captions

Figure 1 Electron microscopic photographs of the initial powders: (*a*) CuO (chemically pure); (*b*) aluminum powder PP-2L; (*c*) CuO after treatment for 60 s; and (*d*) activated mixture Al/CuO 20/80 (100 s) (in reflected electrons with a ring detector, dark particles and aggregates — Al-based phases and light particles — CuO-based phases)

Figure 2 X-ray diffraction patterns of activated Al/CuO samples: *1* — CuO; *2* — Cu_2O; *3* — Cu_4O_3; *4* — Al; *5* — Cu; *6* — γ-Al_2O_3; (*a*) $t_a = 1$ min; and (*b*) $t_a = 12$ min

Figure 3 Change in the phase composition of Al/CuO depending on the activation time: *1* — CuO; *2* — Cu_2O; *3* — Cu_4O_3; *4* — Al; *5* — Cu; and *6* — γ-Al_2O_3

Figure 4 Ignition temperature of activated Al/CuO samples; activation mode 47 Hz (Ak47): *1* — $t_a = 100$ s; *2* — 120; *3* — 150; and *4* — $t_a = 270$ s

Figure 5 Registration of the appearance of conductivity during combustion of activated Al/CuO composition (Ak47-100) in a tube: (*a*) setting up experiments; (*b*) oscillograms of voltage reduction on the capacitor and discharge current; (*c*) front trajectory (*1* — $t_a = 30$ s; *2* — 60; *3* — 90; *4* — 150, and *5* — $t_a = 270$ s); and (*d*) dependence of the speed at the end of the tube on the activation time

Figure 6 Registration of the release of oxygen (mass 32) by the ion current of the mass spectrometer during heating in the calorimeter of ammonium perchlorate (*1* — before activation; *2* — $t_a = 40$ s; and *3* — $t_a = 7$ min) (*a*) and potassium perchlorate (*1* — before activation; *2* — $t_a = 4$ min; *3* — 8; and *4* — $t_a = 30$ min) (*b*)

Figure 7 Electron microscopic photographs of the original (upper row) and activated (lower row) samples of ammonium perchlorate (*a*) and potassium perchlorate (*b*)

Table Captions

Table 1 Results of phase analysis of Al/CuO 19/81 samples, $F = 50$ Hz

Table 2 Phase analysis of Cu and Al/CuO 20/80 samples at reduced frequencies F

Table 3 Results of phase analysis of Al/CuO 20/80 samples, $F = 47$ Hz

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