THE EFFECT OF VARIOUS LOW-ENERGY MECHANICAL ACTIVATION FACTORS ON THE IGNITION TEMPERATURE OF THE 3NI+AL POWDER MIXTURE

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Substance grinding – the stage of many technological processes. The most common is grinding in mills – various types of devices with a chamber inside, where the grinding bodies and the treated material are placed. The mechanical action, produced by the grinding process, reduces the particle size and, moreover, causes various kinds of structural defects due to strong plastic deformations. These processes together lead to change in the free (excess) energy of the substance, thereby reducing the energy threshold for various physico-chemical transformations in it [1-3]. In particular, the energy accumulated during mechanical activation contributes to the implementation of high-temperature synthesis in weakly exothermic systems [4]. The Ni-Al system occupies a special place among such systems. The chemical compounds and composite materials synthesized on its basis have high-strength, heat-resistant properties and can be used in high-capacity power engineering, as well as in the chemical, aviation and space industries [5].

In this paper, the influence of various factors of preliminary low-energy mechanical activation on the conditions of a thermal explosion in a mixture of 3Ni+Al was studied.

For this purpose, special theoretical calculations separating the effects of defect formation and changes in the morphological structure of the reaction mixture due to grinding on its ignition temperature during continuous operation and under conditions of disconnection of an external heating source were carried out.

Based on the results obtained, it can be assumed, that the abnormal decrease in the ignition temperature of the 3Ni+Al powder mixture is mainly caused by morphological changes due to low-energy mechanical activation. These changes, first of all, do not affect the energy, but the kinetic parameters of the subsequent synthesis. It was revealed, that the grinding of the components of the mixture with the formation of mechanical composites leads to a significant decrease in the scale of heterogeneity, on which the diffusion transfer of reagents to the reaction zone is carried out. This increases the number of reaction micro-focuses in the mixture, which helps to decrease the initiation temperature of the subsequent chemical interaction.

However, a qualitative leap in the intensification of the reactivity of the powder composition occurs when an extremely small heterogeneity scale is reached in its structure, in which the following synthesis will be determined not by diffusion with high activation energy, but by boundary kinetics, i.e. directly by chemical processes with low activation energy that do not require the cost of mass transfer of reagents. In other words, low-energy mechanical activation almost does not explicitly store excess energy in the substance, but allows you to move from structures with a large diffusion path to germinal structures ready for rapid conversion of the charge of the initial components into the product of a new phase.

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