STUDY OF BORON PARTICLES AGGLOMERATION DURING COMBUSTION OF HIGH-ENERGY COMPOSITION

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Abstract: Boron is a promising component of energetic condensed systems due to its high gravimetric heat value, which is significantly higher than that of aluminum. However, practical difficulties of boron particles combustion limit the use of boron because of formation of a liquid boron-oxide layer possessing a relatively high boiling point of 2250 °C and, therefore, hindering oxidation of the active boron core. In the present work, boron particles agglomeration and framework (slag) formation processes during combustion of high-energy compositions were investigated experimentally. The quench particle-collection bomb technique was used to collect the condensed combustion products formed under nitrogen pressures of 4.0 MPa. The formation of a framework was visualized using high-speed videoregistration (1200 fps) under nitrogen pressure of 0.1–4 MPa. Particle size, morphology, and surface structure of collected condensed products were evaluated using laser diffractometry and scanning electron microscopy. In the experiments, the weight of the collected condensed combustion products was about 30% of the initial sample weight, where 26% belonged to the products collected from the gas phase and $\sim 4\%$ remained in a highly-porous framework. The initial amorphous boron powder consisted of 1-micron particles, whereas agglomerated particles, which were collected during combustion, were 5 μm in diameter. The burning rate of compositions without binder was 3 times higher and the diameter of collected agglomerates was 10 times larger than those for compositions with binder.

Keywords: energetic condensed systems; agglomeration; boron

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