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 ~ 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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Received November 1, 2014

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