EFFECT OF IRON AND BORON POWDERS ON COMBUSTION OF HETEROGENEOUS CONDENSED SYSTEMS

A. G. Korotkikh¹,², V. A. Arkhipov¹, O. G. Glotov³, V. E. Zarko³, and R. A. Yusupov⁴

¹Research Institute of Applied Mathematics and Mechanics, Tomsk State University, 36 Lenin Av., Tomsk 634050, Russian Federation
²Tomsk Polytechnic University, 30 Lenin Av., Tomsk 634050, Russian Federation
³Institute of Chemical Kinetics and Combustion, Siberian Branch of the Russian Academy of Sciences, 3 Institutskaya Str., Novosibirsk 630090, Russian Federation
⁴Department of Structural Macrokinetics, Tomsk Scientific Center, Siberian Branch of the Russian Academy of Sciences, 10/3 Akademicheskiy Av., Tomsk 634021, Russian Federation

Abstract: The influence of ultrafine powders (UFPs) of iron and amorphous boron on the burning rate and composition of condensed combustion products (CCPs) of heterogeneous condensed systems (HCSs) on the basis of ammonium perchlorate (AP) and butadiene rubber SKDM-80, containing 15.7 % (wt.) of UFP aluminum Alex, was studied. It was found that partial replacement of Alex by 2% (wt.) UFP iron in the composition of HCS leads to the increase of the burning rate by 24% and reduction of the relative masses of CCPs particles by 28% at nitrogen pressure 3.9 MPa in the constant pressure bomb. At partial replacement of UFP Alex by amorphous boron powder, the burning rate of HCS does not change, the relative mass of CCPs increases by 8%, the average diameter of CCP particles $d_{43}$ reduces from 37.4 (Alex) to 33.5 (Alex + Fe) and 32.6 $\mu$m (Alex + B), and the content of aluminum oxide $\alpha$-$\text{Al}_2\text{O}_3$ and carbon nitride $\text{C}_3\text{N}_4$ increases.

Keywords: heterogeneous condensed system; powders of aluminum, iron, boron; condensed combustion products

Acknowledgments

This work was partially supported by the Federal Target Program “Research and development on priority directions of scientific-technological complex of Russia for 2014–2020:” “Developing new HEM and scientific and technical solutions to build perspective schemes for space hybrid rocket motors,” Agreement No. 14.578.21.0034 from 15.06.2014.

References


Received November 1, 2014

Contributors

**Korotkikh Alexander G.** (b. 1976) — Doctor of Science in physics and mathematics, associate professor, Tomsk Polytechnic University, 30 Lenin Av., Tomsk 634050, Russian Federation; senior research scientist, Research Institute of Applied Mathematics and Mechanics, Tomsk State University, 36 Lenin Av., Tomsk 634050, Russian Federation; a_korotkikh@mail.ru

**Arkhipov Vladimir A.** (b. 1944) — Doctor of Science in physics and mathematics, professor, Head of Department, Research Institute of Applied Mathematics and Mechanics, Tomsk State University, 36 Lenin Av., Tomsk 634050, Russian Federation; leva@niipmm.tsu.ru

**Glotov Oleg G.** (b. 1957) — Candidate of Science in physics and mathematics, Head of Laboratory, Institute of Chemical Kinetics and Combustion, Siberian Branch of the Russian Academy of Sciences, 3 Institutskaya Str., Novosibirsk 630090, Russian Federation; glotov@kinetics.nsc.ru

**Zarko Vladimir E.** (b. 1941) — Doctor of Science in physics and mathematics, professor, leading research scientist, Institute of Chemical Kinetics and Combustion, Siberian Branch of the Russian Academy of Sciences, 3 Institutskaya Str., Novosibirsk 630090, Russian Federation; zarko@kinetics.nsc.ru
Yusupov Rashit A. (b. 1956) — Candidate of Science in technology, senior research scientist, Department of Structural Macrokinetics, Tomsk Scientific Center, Siberian Branch of the Russian Academy of Sciences, 10/3 Akademicheskiy Av., Tomsk 634021, Russian Federation; rash1956@yandex.ru