HEAT OF EXPLOSION AND ACCELERATION ABILITY OF MIXTURES OF HIGH EXPLOSIVES WITH TITANIUM AND TITANIUM HYDRIDE

M. N. Makhov

N. N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation

Abstract: The aluminum powder is often used as a component of explosive materials. However, there are some substances that can compete with aluminum. One of these substances is titanium. The evaluation of the potential energy content was performed for the HMX-based compositions containing aluminum, titanium, and titanium hydride. Furthermore, the calorimetric measurements of the heat of explosion (HoE) were carried out. From the data obtained, it follows that the additives considered increase HoE of HMX. However, the measured HoE value is only a part of the potential energy content. The mixtures with micro- and nanosized aluminum are superior to the compositions with titanium and titanium hydride in HoE. The smallest HoE values correspond to the mixtures with titanium hydride; however, these compositions form the greatest number of moles of gaseous products. The acceleration ability (AA) was measured with the use of the method known as M-40 (acceleration of a steel plate from the end of a charge inside the thick-walled steel shell). From the results, it follows that the addition of aluminum, titanium, and titanium hydride enhances AA of HMX as well as of the powerful mixture HMX/bis(trinitroethyl)nitramine. The close values of AA correspond to the mixtures containing aluminum and titanium. The compositions with titanium hydride are inferior to the mixtures with aluminum and titanium in AA.

Keywords: high explosive; heat of explosion; acceleration ability; aluminum; titanium; titanium hydride

Acknowledgments

The research was financially supported by the Russian Foundation for Basic Research (project No. 12-03-00651 a).

References

1. Makhov, M. N. 2002. The effect of charge density on the explosion heat of high explosives. *33rd Annual Conference (International) of ICT Proceedings*. Pfinztal, Germany. 1/73–13/73.
2. Makhov, M. N. 2005. Metod otsenki teploty vzryva alyuminizirovannykh VV [Method for evaluating the heat of explosion of aluminized HE]. *Trudy Mezhdunar. konf. "VII Kharitonovskie tematicheskie nauchnye chteniya"* [Conference (International) "VII Kharitonov Topical Scientific Readings" Proceedings]. Sarov, Russia. 53–58.

3. Imkhovik, N. A. Modelirovanie detonatsionnykh svoystv i osobennostey metatel'nogo deystviya metallizirovannykh VV kak sistem s nemonotonnym energovydeleniem [Modeling of detonation properties and peculiarities of acceleration ability of metallized HE as systems with unmonotonic energy release]. *Trudy Mezhdunar. konf. "XI Kharitonovskie tematicheskie nauchnye chteniya"* [Conference (International) "XI Kharitonov Topical Scientific Readings" Proceedings]. Sarov, Russia. 182–188.
4. Pepekin, V. I., M. N. Makhov, and A. Ya. Apin. 1972. Reaktsii bora pri vzryve [Reactions of boron at explosion]. *Fiz. Goreniya Vzryva* 8(1):135–138.
5. Il'in, A. P., and A. A. Reshetov. 1999. Sostav kondensirovannykh produktov detonatsii smesevykh vzryvchatykh veshchestv [Composition of condensed products of detonation of composite high explosives]. *Fiz. Goreniya Vzryva* 35(4):92–94.
6. Makhov, M. N. 2001. Determining the energy content of individual HE. *Chem. Phys. Reports* 19(6):1155–1160.
7. Makhov, M. N. 2011. Opredelenie teploty vzryva alyuminizirovannykh VV [Determining the heat of explosion of aluminized HE]. *Goren. Vzryv (Mosk.) — Combustion and Explosion* 4:307–312.
8. Zhigach, A. N., I. O. Leypunskiy, M. L. Kuskov, N. I. Stoenko, and V. B. Storozhev. 2000. Ustanovka dlya polucheniya i issledovaniya fiziko-khimicheskikh svoystv nanochastits metallov [Apparatus for production and study of metal nanoparticles]. *Pribory i tekhnika eksperimenta* [Instruments and Experimental Techniques] 43(6):122–129.
9. Orlenko, L. P., ed. 2002. *Fizika vzryva* [Physics of explosion]. 3rd ed. Moscow: Fizmatlit. Vol. 1. 832 p.

Received November 1, 2014

Contributor

Makhov Michael N. (b. 1946) — Candidate of Science in chemistry, leading research scientist, Department of Combustion and Explosion, N. N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; makhov@polymer.chph.ras.ru