MECHANOACTIVATED THERMITE COMPOSITION Al/CuO

A. Yu. Dolgoborodov[1,2,3], V. G. Kirilenko[1], A. N. Streletskii[1,3], I. V. Kolbanev[1], A. A. Shevchenko[1,2], B. D. Yankovskii[2], S. Yu. Ananev[2,4], and G. E. Val'yano[2]

[1]N. N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation
[2]Joint Institute for High Temperatures, Russian Academy of Sciences, 13-2 Izhorskaya Str., Moscow 125412, Russian Federation
[3]National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), 31 Kashirskoe Sh., Moscow 115409, Russian Federation
[4]Moscow Institute of Physics and Technology (State University), 9 Institutskiy Per., Dolgoprudny, Moscow Region 141701, Russian Federation

Abstract: The paper presents new experimental results on mechanical activation and combustion of thermite compositions based on mixtures of micron- and nanosized powders of aluminum and copper oxide. Optimum activation conditions in ball mills for obtaining compositions with maximum reactivity were determined. The dependences of the ignition temperature, burning rates, and brightness temperature of the products on the conditions of mechanical activation were obtained.

Keywords: aluminum; copper oxide; mechanical activation; reactivity; combustion

DOI: 10.30826/CE18110315

Acknowledgments

The work was supported by the program of fundamental research of the Presidium of RAS "Condensed matter and plasma at high energy densities" and by the Russian Foundation for Basic Research projects 16-29-01030ofi-m and 16-03-00178a. The authors thank G. A. Vorobieva and A. V. Leonov for the measurements by DSC and X-ray phase analysis. The equipment of the explosive center for collective use (CKPV) was used in the experimental studies.

References

1. Dolgoborodov, A. Yu. 2015. Mechanically activated oxidizer–fuel energetic composites. *Combust. Explo. Shock Waves* 51(1):86–99.
2. Dreizin, E. L., and M. Schoenitz. 2017. Mechanochemically prepared reactive and energetic materials: A review. *J. Mater. Sci.* 52(20):11789–11809.
3. Streletskii, A. N., M. V. Sivak, and A. Yu. Dolgoborodov. 2017. Nature of high reactivity of metal/solid oxidizer nanocomposites prepared by mechanoactivation: A review. *J. Mater. Sci.* 52(20):11810–11825.
4. Thiruvengadathan, R., A. Bezmelnitsyn, S. Apperson, C. Staley, P. Redner, W. Balas, S. Nicolich, D. Kapoor, K. Gangopadhyay, and S. Gangopadhyay. 2011. Combustion characteristics of novel hybrid nanoenergetic formulations. *Combust. Flame* 158(5):964–978.

Received December 25, 2017

Contributors

Dolgoborodov Alexander Yu. (b. 1956) — Doctor of Science in physics and mathematics, chief research scientist, N. N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; head of laboratory, Joint Institute for High Temperatures, Russian Academy of Sciences, 13-2 Izhorskaya Str., Moscow 125412, Russian Federation; teacher, National Research Nuclear University MEPhI, 31 Kashirskoe Sh., Moscow 115409, Russian Federation; aldol@ihed.ras.ru

Kirilenko Vladimir G. (b. 1956) — Candidate of Science in physics and mathematics, senior research scientist, N. N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; vladkiril@gmail.com

Streletskii Andrey N. (b. 1945) — Doctor of Science in chemistry, head of laboratory, N. N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; acting

professor, Moscow Institute of Physics and Technology (State University), 9 Institutskiy Per., Dolgoprudny, Moscow Region 141701, Russian Federation; str@center.chph.ras.ru

Kolbanev Igor V. (b. 1937) — senior research scientist, N. N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; str@center.chph.ras.ru

Shevchenko Arseniy A. (b. 1991) — research engineer, N. N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; PhD student, National Research Nuclear University MEPhI, 31 Kashirskoe Sh., Moscow 115409, Russian Federation; arsshevchenko@inbox.ru

Yankovskii Boris D. (b. 1947) — Candidate of Science in physics and mathematics, senior research scientist, Joint Institute for High Temperatures, Russian Academy of Sciences, 13-2 Izhorskaya Str., Moscow 125412, Russian Federation; yiy2004@mail.ru

Ananev Sergey Yu. (b. 1990) — junior research scientist, Joint Institute for High Temperatures, Russian Academy of Sciences, 13-2 Izhorskaya Str., Moscow 125412, Russian Federation; PhD student, Moscow Institute of Physics and Technology (State University), 9 Institutskiy Per., Dolgoprudny, Moscow Region 141701, Russian Federation; serg.ananev@gmail.com

Val'yano Georgii E. (b. 1945) — senior research scientist, Joint Institute for High Temperatures, Russian Academy of Sciences, 13-2 Izhorskaya Str., Moscow 125412, Russian Federation; gvalyano@yandex.ru