OPTICAL PROPERTIES OF PYROTECHNIC COMPOSITIONS

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Abstract: A method for estimating the transparency for the radiation of an iron–aluminum thermite of moderate gravimetric density is proposed. The transparency of such compounds is caused by their porosity. It is assumed that the patterns of light reflection from the outer surface of the sample are similar to those in the pores. The experimentally known dependence between the reflection coefficient and density for model compositions (coarse) ammonium perchlorate + (fine) aluminum ($\sim 25\%$) and the transmission dependence of content of aluminum found for compositions with a small amount of aluminum ($\sim 0.2\%$) but pressed to the maximum density have been used. It is shown that in the first case, starting with a relative density of $\Delta\rho \geq 0.3$, the reflection coefficient does not increase with the density of the observed composition. In the second case, the dependence is linear. To determine the transmission coefficient of a porous composition with a large amount of aluminum, it is necessary to set a conditional concentration of Al. This value is calculated based on the assumption that the fine Al powder, due to the adhesion of individual particles, consists of separate agglomerates containing 8–10 particles. After that, according to the linear dependence in the second case, the transmission coefficient has been found. So, for an iron–aluminum termite, the transmission parameter k is 10^3–10^4 cm^{-1} that agrees with the data given in the literature.

Keywords: pyrotechnic compositions; laser pulse; explosion; combustion

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Figure Caption

The relationships between the transmission parameter k and amount of Al in the composition of TEN + Al (*a*) and between k and the sample thickness d (*b*)

Table Caption

Experimental values of the reflection coefficient r_{el} for pyrotechnic composition with 25% Al at different relative densities of the composition

References

1. Shidlovsky, A. A. 1973. *Osnovy pirotekhniki* [Fundamentals of pyrotechnics]. Moscow: Mashinostroenie. 320 p.
2. Medvedev, V. V., E. P. Ageeva, V. P. Tsipilev, and A. N. Yakovlev. 2008. Size effect in laser-induced initiation of a pyrotechnical composition (ammonium perchlorate and ultrafine aluminum). *Combust. Explo. Shock Waves* 44(6):685–689.
3. Medvedev, V. V. 2009. Effect of the density of an ammonium perchlorate – ultradispersed aluminum composition on the threshold of its ignition by a millisecond-long laser pulse. *Russ. J. Phys. Chem. B* 3:82–84. doi: 10.1134/S1990793109010138.
4. Burkina, R. S., O. V. Khrenova, and V. V. Medvedev. 2010. Size effect during ignition of a condensed material by a light pulse. *Combust. Explo. Shock Waves* 46(5):554–563.
5. Aduev, B. P., D. R. Nurmukhametov, G. M. Belokurov, and R. I. Furega. 2015. Studies of the contribution of light scattering and absorption by inclusions of aluminum nanoparticlese in PETN. *Combust. Explo. Shock Waves* 51(3):347–352.
6. Ivanov, A. P. 1969. *Optika rasseivayushchikh sred* [Optics of scattering media]. Minsk: Science and Technology. 592 p.

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