Effect of Me/B-powder on ignition and combustion of HEMs

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The study of the ignition and combustion characteristics of high-energy materials (HEMs) is important in solving a number of practical problems related to the assessment of explosion safety, the calculation of transition processes in power installation for various purposes (rocket and space technologies, weapons, pyrotechnics). To improve the ignition and combustion characteristics of HEM, the combustion catalysts, powders of various metals or their oxides are used. In order to increase the combustion heat and ignition characteristics of HEM, boron-based powders or metal borides are used. []. This paper presents the experimental data on the experimental characteristics of the ignition and combustion of HEM based on ammonium perchlorate, butadiene rubber, and metal fuel base on Me/B-powder. It was shown that the use of 15.7 wt.% the mixed ultrafine powders (UFP) based on Al/B, Ti/B, Ni/B or Fe/B in HEM reduces the ignition delay time by 7–50% compared to boron-based HEM in the range of heat flux density from 60 to 200 W/cm^2. Based on experimental data of the ignition delay time versus the heat flux density, the formal activation energy, the multiplication of the specific heat flux of the reactions by the pre-exponent and the ignition temperature are calculated which could be used in mathematical modeling of the ignition for composite solid propellant containing metal fuels. We carried out a series of combustion measurements for the metallized HEM compositions in the range of nitrogen pressure of 0.5–5.0 MPa. The burning rate and power exponent were determined for the test HEM compositions in a constant pressure bomb. It was established that the complete replacement of amorphous boron by mechanical mixture of Fe/B, Ti/B and Al/B in HEM increases the burning rate of the HEM sample by 1.2–3.4 times depending on pressure. The mechanical mixture of Al/B UFP is the most effective to increase the burning rate of HEMs based on AP and butadiene binder.

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