Explosive decomposition of high explosives with inclusions of ultrafine metal particles under the influence of pulsed laser radiation

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It has been established that the role of ultrafine (~100 nm) metal inclusions (Al, Ni, Fe) in explosives (PETN, RDX) is to change its optical characteristics as a result of absorption of laser radiation by the metal core of the inclusions, followed by heating of the core. When the critical radiation energy density in the explosive shell surrounding the inclusion is exceeded, an exothermic chemical reaction is initiated. It is shown that the nature of the dependence of the threshold of laser initiation (1064 nm, 532 nm, 14 ns) of the explosion of blasting explosives on the mass fraction of ultrafine metal particles is related to the nature of the change in pressure in the energy absorption layer, which is determined by the conditions of gas dynamic unloading. The dependence of the laser initiation threshold for an explosion of brisant explosives on the size of inclusions of ultrafine metal particles is related to the dependence of the radiation absorption index on the particle size. The dependence of the threshold of laser initiation of an explosion of polycrystalline PETN samples with inclusions of ultrafine metal particles on the wavelength is related to the radiation absorption efficiency coefficients. For the same values of the extinction index, the thresholds for initiating an explosion when exposed to different wavelengths are the same. In thin (1 mm) PETN samples with inclusions of ultradisperse aluminum particles under laser irradiation, regularities of explosive decomposition are manifested, which differ from regularities during normal detonation. With a decrease in the sample density, the thresholds of laser initiation of an explosion, as well as the velocities and pressures of shock waves generated during the explosion of samples in air, increase. The primary product during laser initiation of an explosion of explosives (PETN, RDX) with inclusions of ultrafine particles of Al, Ni and Fe is NO^{2}* - radicals formed in "hot spots" as a result of the dissociation of the explosive molecule. The luminescence spectra at the explosion stage are of a thermal nature and are associated with a chemical reaction in the core of the explosive molecules. Based on the studies carried out and the analysis of their results, a model of laser initiation of the explosive decomposition of brisant explosives with inclusions of ultrafine metal particles is proposed.