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Initiation of the explosion of PETN by pulse first and second harmonics of neodymium laser at elevated temperatures

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Abstract

In this work, the influence of the initial temperature on the threshold of the explosive decomposition of PETN under the action of pulses of the first (1064 nm) and second (532 nm) harmonics of a neodymium laser (τ = 14 ns) is investigated. The absolute values of the critical energies at the initiation by the first harmonic exceed those at the initiation by the second harmonic in the entire temperature range studied. This is due to the difference in the radiation absorption efficiency of the first and second harmonics of the laser by PETN. A model has been developed for processing experimental data, according to which the absorption of laser radiation occurs at structural defects of PETN. As a result of the absorption of structural defects, the formation of chemical decomposition centers occurs. This process requires activation energy. Within the framework of the model, differential equations are written and solutions are obtained that satisfactorily describe all the experimental data in the investigated range of initial temperatures (360-445 K). It has been suggested that the primary act in the absorption of laser radiation may be ionization of the PETN in the vicinity of a structural defect, where the binding energy of the valence electron may be small. The first stage of a chemical reaction that requires thermal activation energy can be the removal of the NO_3 radical from the ionized PETN molecule. The same values of the activation energy E ≈ 0.4 eV were obtained when initiating of PETN explosion, both for the first and second harmonics of the laser. The same values of the activation energy E when initiating an explosion of PETN of the first and second harmonics of the laser allow us to conclude that after absorption of the light energy, the development of a chemical reaction in both cases proceeds according to the same scheme. The difference lies in the mechanisms of absorption of radiation energy.

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