Shock initiation of detonation in heterogeneous explosives based on nitromethane

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The liquid explosive nitromethane (NM) is of great interest for the study of detonation processes. Its detonation properties are well investigated and are determined by a chemical reaction occurring uniformly throughout the entire volume of the shock-compressed substance [1]. The addition of various microballoons dramatically changes its sensitivity to shock-wave action and critical diameter [2]. This is a consequence of the appearance of hot spots in which the rate of chemical reaction increases, and the decomposition of explosive becomes heterogeneous in volume. Mixtures of NM with calibrated glass microspheres are ideal for research, analysis and numerical modeling, since hotspots of the same size and temperature are obtained under compression.

In this work, the influence of glass microballoons on the shock initiation of detonation and critical diameter of nitromethane is investigated. In the experiments, NM with a density of 1.12 g/cc and the hollow glass microballoons with an average diameter of 70 μm and a density of 0.14 g/cc are used. A VISAR interferometer recorded particle velocity profiles and measured the detonation velocity in a mixture of gelled NM with microballoons. Studies have shown that when adding 5 wt.% of microballoons, a sharp decrease in the critical diameter of gelled NM from 16,5 mm to 5 mm is observed. The threshold of shock-wave sensitivity is also significantly dropped. In NM it exceeds 7.7 GPa, and the addition of microballoons reduces the initiation pressure several times. It was found that at 5 wt.% of microspheres, a shock wave with an amplitude of 2 GPa leaded to the initiation and development of detonation. Moreover, the character of initiation is different from that observed in NM, where the period of induction is clearly expressed. But in the mixture of gelled NM/microballoons 95/5, the reaction begins immediately after the shock jump.

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