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PROCEEDINGS

Investigation of Dynamic Damage Response of PBX Using Peridynamics Simulation

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ABSTRACT

Polymer bonded explosives (PBXs) are one of typical heterogeneous materials comprised of solid energetic particles surrounded by a polymer binder. PBXs are widely encountered in various applications such as rocket propellants and main explosive charges. PBXs can ignite or detonate due to an accidental impact loading, which usually leads to serious losses to personnel and property. Therefore, safety of PBXs regarding to various loading conditions is of great concern.

The ignition of PBXs due to impact is a mechanical-thermal-chemical coupled phenomenon. The evolutions of micro-cracks and other damage behaviors are essential to help understanding of ignition phenomena induced by low-medium impact velocities but relatively long duration period, which is referred to the non-shock ignition. A mechanical-thermal-chemical coupled framework based on peridynamics (PD) focusing on the non-shock ignition of explosives was developed. Then the dynamic damage response of PBX under impact loading was investigated. The PD simulation results indicated that the inter-granular damage and trans-granular damage can occur during the impact process and the damage patterns of explosive are actually dependent on both the impact strength and material properties. Moreover, the effects of external confinement on dynamic response of PBX were also investigated. The combined influences of stress wave dynamics and impact speeds on dynamic damage of PBX was highlighted. The ignition behaviors of PBX in a confinement structure under various impact speeds were also discussed based on PD simulation results. The simulation results show that PD can well capture the characteristics of dynamic damage behaviors of PBXs. The mechanical-thermal-chemical coupled framework based on PD theory can be an effective tool to simulate non-shock ignition of PBX under impact loading due to its advantage allowing spontaneous formation and evolution of cracks.

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