HETEROGENEOUS BLAST EFFECTS DURING SUPERSONIC IMPACT OF METAL FRAGMENTS

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Key words: Supersonic projectile impact, metal fragmentation, metal reaction, blast wave

Abstract: Detonation of a high-explosive charge surrounded by a layer of metal particles or a metal casing will accelerate the particles or casing fragments to speeds on the order of 1 km/s. If the charge is located near a rigid wall or confined within a closed volume, impact of the supersonic reactive metal particles with adjacent walls can lead to particle fragmentation and reaction of the fine fragments. The mechanical impact with the walls will generate an impulsive force that depends on the elasticity of the collision. If the impact occurs in a partially closed chamber, as in the vented chamber calorimetry technique [1], the increase in the gas pressure provides an indirect measure of the rate of the metal energy release. If the particles impact the wall coincident with the arrival of the blast wave from the charge, shock-particle effects can influence the wall loading [2]. In the present experiments, metal projectiles are accelerated with a light gas gun and impact a rigid plate without the presence of an initial blast wave. The impact, fragmentation, and reaction of the fragments are visualized with sub-microsecond-resolution videography. The temperature of the fragments formed during impact is inferred using imaging pyrometry. It is observed that a jet of fine fragments is formed during projectile deformation and the motion of the jet as well as the combustion of the fine fragments both contribute to the formation and symmetry of the blast wave that propagates away from the impact location. The effects of the initial impact velocity, particle material, and the ambient oxidizing gas on the blast wave formation is explored.

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