ACCELERATION, HEATING AND REACTION OF ALUMINUM PARTICLES IN CONDENSED EXPLOSIVE DISPERSAL

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ABSTRACT

Above the detonation failure diameter for explosive charges containing metallic particles, there exists a second critical diameter for particle ignition, or CDPI [1], where prompt reaction of dispersed metal particles occurs. In general, the CDPI increases with increasing particle diameter; however, for aluminum particles in cylindrical explosives, experiments in light glass casing have shown the CDPI to also increase in the small particle limit, creating a U-shaped curve with the minimum CDPI near a mean particle size of 54 μm [2]. When the glass casing is changed to an aluminum or steel casing, the typical CDPI trend can be recovered [3]. For essentially uncased conditions involving spherical aluminum particles, this non-monotonic behaviour in the small particle regime has yet to be resolved. While experiments have demonstrated the key phenomena, the physical mechanisms responsible for CDPI are explored in the present work using numerical simulations. Physical models for shock compression acceleration and heating are combined with a hybrid reaction model to capture the very near field flow leading to particle ignition, such that the CDPI behaviour can be better understood.