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Reaction of Titanium and Zirconium Particles in Cylindrical Explosive Charges DAVID FROST, MALCOLM CAIRNS, SAMUEL GOROSHIN, McGill University, FAN ZHANG, DRDC-Suffield — The critical conditions for the reaction of high melting-point metallic particles (Ti, Zr) dispersed during the detonation of long cylindrical explosive charges have been investigated experimentally. The charges consisted of packed beds of either spherical titanium particles (with diameters of 35, 90, or 215 μm; AP&C, Inc.) or nonspherical zirconium particles (250 – 500 μm or 500 – 600 μm, Atlantic Equipment Eng., NJ) saturated with sensitized liquid nitromethane. For the titanium particles, a threshold particle diameter exists, above which self-sustained particle reaction is not observed, although some particle reaction occurs immediately behind the detonation front then rapidly quenches. For the smallest particles, the proportion of the conical particle cloud that reacts increases with charge diameter, suggesting that the reaction initiation is a competition between particle heating and expansion cooling of the products. For zirconium particles, no critical conditions exist; particle ignition was observed for all particle and charge diameters tested. In this case, interaction of the high pressure detonation wave with the particles is sufficient to initiate reaction at the particle surface after a delay time ($\sim$ 10's μs), which is much less than the time required for thermal equilibration of the particles.

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