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Cellular Structure and Oscillating Behavior of PBX Detonations[1]

IGOR PLAKSIN, RICARDO MENDES, ADAI/LEDAP - University of Coimbra, PORTUGAL — Efforts are aimed on bridging experimental and theoretical studies of localizations/instabilities manifested in detonation reaction zone (DRZ) at micro-, meso-, and macro-scale. In molecular level, the theoretical/computational studies of detonation (RDX, HMX) show: reaction localizations onset/growth is caused by kinetic nonequilibrium stimulated by different levels of activation barriers/reaction energies at bonds dissociation processes (C-NH2, C-NO2, C=C). At micro- and meso-scale levels, leading role of kinetic nonequilibrium in reaction localizations onset was established in experiments with single beta-HMX crystals-in-binder subjected to 20 GPa-shock and PBX detonation. Reaction localizations and further ejecta formation were spatially resolved by 96-channel optical analyzer at simultaneous recording reaction light and stress field around crystal. Spatially-resolved measurements reveal fundamental role of shear-strain in triggering initiation chemistry. At macro-scale level, formation of the cell-structures and oscillating detonation regimes revealed in HMX- and RDX-based PBXs at wide variation of grain-sizes, wt. % filler/binder, residual micro-voids and binder nature. Emphasizes placed on effect of DRZ-induced radiation upon oscillating regimes of detonation front motion.

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