UNDERSTANDING ENHANCED BLAST EXPLOSIVES: A MULTI-SCALE CHALLENGE

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Unlike predictive models for conventional high explosives, modeling enhanced blast explosives (EBX) is complicated by the need to resolve events occurring over a range of length scales. From the initial detonation and subsequent material dispersal at the mesoscale, to turbulent mixing with the environment at the computational grid scale, to the combustion processes at the subgrid scale, accurately capturing the inherent processes at each scale is the only approach to yield a truly predictive model of performance. At Sandia National Laboratories, a modeling and experimental thrust is underway to understand enhanced blast explosives. This talk will highlight the challenges that are faced when both models and experiments utilize a multi-scaled approach.

Predicting near-field behavior involves assessing the detonics behavior and material dispersal, at the mesoscale. Our model combines a shock physics code with a nonequilibrium multiphase mixture model which produces detonation wave speeds and dispersed particle velocities that are well-matched to experiments. Predicting far-field behavior is complicated by the need to assess the onset of multiphase unstable flows, a prelude to secondary combustion effects. Here, the challenge for modeling the pressure response from an EBX is predicting the local turbulent mixing environment of the multiphase flow in the far-field. Our combustion modeling approach is based on the formalism of probability density function (PDF) theory which combines large eddy simulation with a subgrid scale multiphase combustion model. Additional challenges are faced when developing experiments to validate far-field model results. Typical experimental diagnostics such as impulse, blast and pressure gauges produce integrated results over long times. These methods are insufficient in isolating the late-time and far-field for comparison to predicted quantities. Novel diagnostics, such as 3-color pyrometry, are being implemented in an effort to unravel far-field processes with higher resolution.