Non-Ideal Explosives Characterization

Abstract:
Non-ideal detonation is poorly understood and can be very unstable and therefore difficult to measure and even even harder to predict. Materials above a certain energy density are required to be subjected to testing to screen for its potential explosive hazard. If the unidentified material fails to perform explosively in these conventional department of transportation tests, it is labeled as a non-explosive. These tests are inherently inconclusive of a material's potential detonability in the case of a 'no-go' result. The material may still, in fact, be an explosive hazard if a different charge configuration was used, in particular a larger one. The industrial sector needs small-scale screening tests which can identify non-ideal explosive materials without requiring several large (often ton-scale) tests in multiple configurations to determine if a questionable material could pose an explosive hazard in any potential configuration.

Conventional explosives have been studied and characterized with great accuracy and predictability; their thermodynamic equation of state and initial conditions dictate steady detonation parameters which have been used to accurately predict the performance of devices with wildly different configurations than those used to calibrate the models. Modern munitions are being developed and used which are particularly insensitive; these materials tend to perform non-ideally, which makes them very difficult to predict without expressly testing them in each desired configuration. The weapons community needs a small-scale research tool to help identify reaction parameters in these materials in different configurations quickly and efficiently.

Improvised explosives utilized by terrorists are often mixtures of oxidizers and fuels. Depending on many initial state factors (particle size, density, reactivity, confinment, etc) these materials may become a new class of hazard in a clandestine device if they can be configured to detonate. This infinite compositional matrix of potential explosives demands a test which can identify detonable character in a particular mixture without the need to achieve that material's critical diameter which may be excessively large.

These problems are being addressed by our research efforts and detailed descriptions of our diagnostic toolbox and device configurations are presented.