Energetic Materials

ONR Program Code 35

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At a Glance

What is it?

- Research to provide higher performance ordnance with acceptable insensitivity characteristics; includes explosives and propellants
- Focused on understanding of molecular design, synthesis, spectroscopic characterization and process research and development issues associated with energetic ingredient preparation

How does it work?

- Understanding of EM initiation, combustion and detonation processes coupled with knowledge about types and quantities of crystal defects in EM
- Understanding first-principles is the basis of more accurate large-scale simulations, reducing the number of tests necessary to qualify new munitions

What will it accomplish?

- Military strike and logistics payoffs applicable across all ordnance systems
- Process refinement and scale-up activities providing consistent, reproducible and well characterized materials to reduce acquisition cost
- Enable enhanced survivability, reduced operational and logistic burdens, improved operational tempo with respect to load out and sortie rates, and reduced EM initiation sensitivity by external stimuli
- Combined kinetic and chemical energy in a weapon system with greatly enhanced lethality

Point of Contact

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Energetic materials (EM) weapon systems can be a “Game Changer” by increasing the warfighters’ lethality and area of dominance. Catastrophic damage improves battlefield damage assessment and reduces sorties. Equally powerful, but smaller weapons optimize internal carry and facilitate higher weapon load outs. Future new ordnance must be adaptable in size to fit a family of delivery systems, contain sufficient energy to defeat the target, and be affordable.

The vast majority of explosives use energetic materials to some degree. Energetic materials are used safely in actuators, demolition charges, aircrew escape, missile deployment applications, starter cartridges, gas generators, and airbags. EM research, development and manufacturing technology encompass a broad science and engineering spectrum: basic molecular chemistry, detonation physics, combustion processes, pyrotechnic mapping, material science, lethality effects, process chemistry and engineering, and manufacturing technology.

Another EM thrust is related to advanced blast and propellant compositions which rely on Ammonium Perchlorate (AP) to assist combustion and detonation characteristics. Current AP systems have reached their engineered maximum efficiency, mandating the requirement for new ingredients to continue performance and sensitivity property advances.

Payoffs:

- 10X increase in performance
- Insensitive Munitions (IM) Compliant
- Prolonged storage life (40-50 years)
- Safe handling
- Flexibility in size and weight
- Maximize energy on target compared to traditional weapons, resulting in enhanced lethality and improved weapon effectiveness

Research Challenges and Opportunities:

- New approaches to novel materials that maximize molecular design, synthesis efficiencies, predicted stabilities and achieve performance goals
- Develop a new class of ingredients that can surpass the oxygen content of AP
- Development of macroscopic mechanical and chemical models; an understanding of molecule dynamics; strength/reactivity correlations
- Consistent processing and performance results; process research and development (commonly referred to as “scale-up”); areas of concern are safety and remote operations, critical thermal management, batch to batch reproducibility, standardized process for the chemistry, and conditions and product quality and purity