At a Glance

What is it?
- Insensitive munitions (IM) compliance is a requirement for all weapons in the fleet. Unfortunately, over 80% of the DoD munitions inventory is still non-compliant. CSIM technology will enable reduced sensitivity ordnance items for all classes of fleet weapon systems.

How does it work?
- With an expanded fundamental understanding of energetic materials initiation, combustion and detonation processes coupled with knowledge about the types and quantities of crystal defects that exist in energetic materials, weapons designers will be able to develop improved compositions with improved insensitivity characteristics.
- Incorporation of these physical inputs into advanced microscopic to mesoscopic modeling efforts will provide a rapid and accurate assessment of new compositions and formulations for advanced weapons system use and reduce IM test time and costs.
- Understanding the first-principles is the basis for the development of more accurate large-scale simulations, thus reducing the number of dangerous and expensive tests necessary to qualify new munitions.

What will it accomplish?
- Mission requirements impose conflicting demands for weapon systems. The warfighter wants significant enhancements in delivery energy in compact volumes and also wants the weapon to be resistant to catastrophic failure in extremely stressful environments be they during transportation, loading, or storage on land or sea.

Point of Contact
Dr. Clifford Bedford, ONR Code 351
clifford.bedford@navy.mil

The Need for IM Compliance
The Navy has grave concerns over conventional munitions and propellant systems, since all munitions are stored on maritime platforms. It is critical that conventional munitions display maximum insensitivity when stowed, handled, carried or otherwise exposed to friendly forces and environments, but have sufficient energy/lethality to perform mission expectations reliably. This balance between sensitivity and performance is at the focal point of the CSIM program.

A secondary factor imposed upon Navy and Marine platforms reflects ordnance performance and load outs. To deliver the greatest lethality weapons, the highest performance munitions/energetic compositions are required. To assist the Navy in meeting this requirement, the advanced energetic materials program is exploring new ways of thinking about delivery of energy on target and ways to enhance performance while increasing or improving IM characteristics.

This program will establish the computational and synthetic chemistry foundations required to target the next generation of energetic ingredients capable of resisting inadvertent thermal and shock loading conditions based on the following derived synthesis hypotheses:
- Increase Inter and Intra Molecular Hydrogen Bonding
- Delocalize Electron Density in Nitro Groups
- Utilize Coulombic Attractions to Stabilize the Ground-State Structure
- Reduce the Number of Nitro Groups
- Avoid High Acidity
- Maximize Crystal Packing Planarity

The implementation of CSIMs will:
- Enable compliance with insensitive munitions mandates.
- Substantially enhance ship survivability in case of an accident or attack by eliminating the risk of sympathetic detonation.
- Reduce the logistical and operational overburden currently imposed in order to satisfy load, stow, handle, and launch non-compliant munitions; thus improving efficiency and reducing cost, with concomitant improvements in pace of operations and potential reduction in manning requirements.

Research Challenges and Opportunities:
- Establish the connectivity between molecular structure, crystal morphology prediction and synthesis chemistry to provide IM compliant energetic ingredients shock and thermal sensitivity
- Focus modeling and simulation to predict stable crystal structures/crystal morphology
- Establish methodologies to model, measure and predict molecular and crystal energetic material response to external shock and thermal modeling
- Validate design criteria for molecular stability as a function of insensitivity

www.onr.navy.mil