

Patent Pending
SD 14090.2

Technology Readiness Level: 3

Concepts have been demonstrated experimentally and described in several publications

Improved control of initiation and detonation from enhanced substrates with minimal post-processing and fabrication compared to traditional explosive processes

In high explosives, the density and porosity of energetic materials contributes to initiation and detonation characteristics. Traditional explosive processing methods like melt casting or powder pressing are known for their less than optimal control of initiation and detonation characteristics due to variations in these key areas.

Researchers at Sandia National Laboratories have developed substrates enabling improved control of explosive film density and porosity – and therefore initiation and detonation characteristics – with minimal post-processing or material fabrication. Enhanced detonation velocity, yield, and control over sensitivity is valuable for the application of explosives in defense, mining, and research fields.

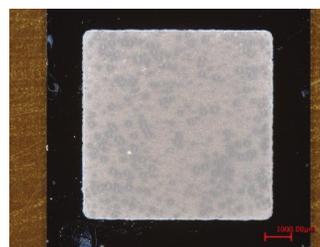
Scalable, economical control with less processing

This technique leverages physical vapor deposition (PVD) and substrate modification to augment energetic film density and porosity in a scalable and economical manner. More than a 10% variation in local pentaerythritol tetranitrate (PETN) density is achievable without explosive pressing operations. Interfaces are prepared in a vacuum chamber to control crystallographic orientation and grain structure during nucleation and film growth. This efficient technique enables tuning of density, porosity, and other energetic film parameters important to detonation.

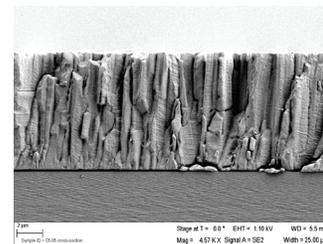
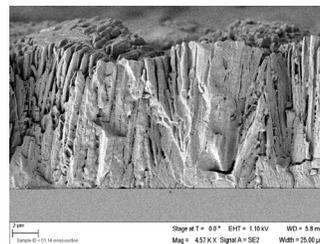
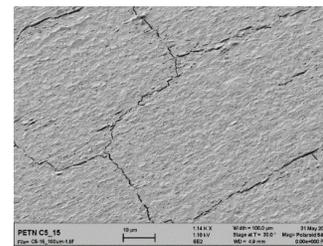
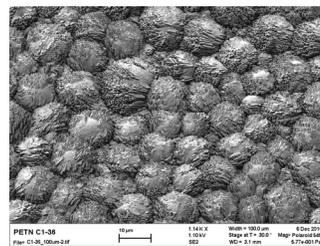
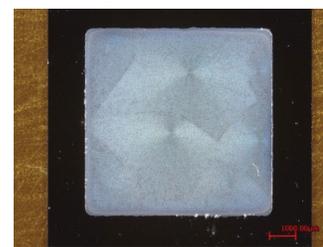
TECHNICAL BENEFITS

- Improved control of initiation and detonation through enhancement of substrate surface energy
- More than a 10% variation in local PETN density achievable without explosive pressing operations
- Improved consistency in detonation and scalability
- Optimized explosive density with no additional explosive processing or handling
- Greater safety and assurance

Low Surface Energy:
1.55 g/cm³ PETN Density



High Surface Energy:
1.75 g/cm³ PETN Density



Optical microscopy and SEM images of PETN films on low surface energy (left) and high surface energy substrates (right). Fracture cross-sections (bottom) show a reduction in porosity and increase in density for PETN grown on high surface energy substrates.

INDUSTRIES & APPLICATIONS

- Defense
- Explosives
- Mining