Topic: N171-060

E&G Associates, Inc.

Development of Explosive Feedstock for Commercial-off-the-Shelf (COTS) 3D Printers

The technology consists of a specialized powder feedstock for 3D printing of energetic structures utilizing Hewlett-Packard's commercial-off-the-shelf line of 3D printers. The initial target application of the developed technology is ongoing research into novel shaped charges, for maximizing payload efficiency. Initial material formulations have been synthesized and tested on test beds simulating a production scale 3D printer. Sustained competitive advantage is provided as the technology being developed allows for low cost, low waste deployment of customized energetic structures with decreased lead times while being based on a decentralized production chain. E&G Associates specializes in the development of custom powder materials and processes with an emphasis on practical engineering techniques.

Technology Category Alignment:

Ordnance
Propulsion
Propulsion and Extreme Environments

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SYSCOM: NAVSEA
Contract: N68335-19-C-0169

Department of the Navy SBIR/STTR Transition Program

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NAVSEA #2019-0584

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Development of Explosive Feedstock for Commercial-off-the-Shelf (COTS) 3D Printers

E&G Associates, Inc.

WHO

SYSCOM: NAVSEA

Sponsoring Program:

Transition Target:

TPOC:
(301)744-4766

Other transition opportunities:
Energetic material RDT&E efforts

Notes: Pictured is the detonation of a 3D printed small scale test object created using plastic bonded explosive feedstock powder developed during Phase I.

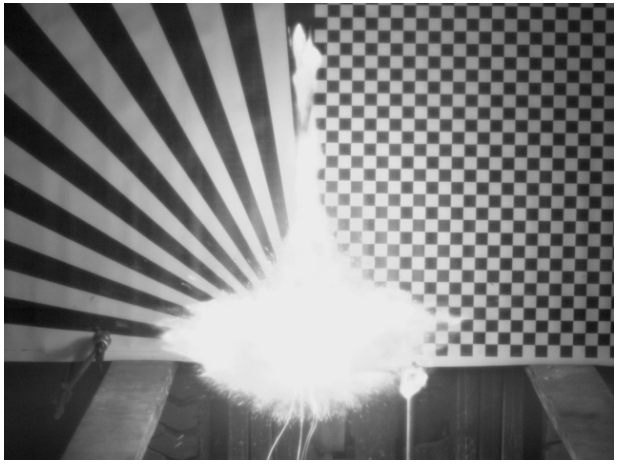

Image courtesy of E&G Associates, Inc.

WHAT

Operational Need and Improvement: Often production volume for ordnance is low. For traditional manufacturing techniques (cast, molded, machined) this translates to high per unit cost, less flexibility, and longer lead times. Additive manufacturing (AM) offers an alternative to traditional manufacturing technologies. Employing additive manufacturing in the production of small batch warhead, propellant and pyrotechnic systems would enable the fast production of multiple components with minimal start up cost, and therefore a lower per part cost. To this end, it was desirable to develop this capability for availability to the Navy. In particular, it is the objective of the U.S. Navy to develop explosive feedstock for the production of ordnance by commercial-off-the-shelf (COTS) 3D printers. In response to this need, E&G Associates, Inc. has undertaken work to develop a polymer bonded explosive powder for use on commercially available powder bed fusion printers (PBF).

Specifications Required:
1) An explosive feedstock material that operates on commercial off the shelf 3D printers with no system modification.
2) Satisfies mechanical, chemical, and aging property requirements for the ordnance.
3) Maintain performance and safety of a comparable qualified explosive formulation.
4) Enable small production runs of 100- 1,000 units at a 25% per unit cost savings over current manufacturing techniques.

Technology Developed: E&G Associates has developed a plastic bonded explosive (PBX) material as a feedstock for use in commercial-off-the-shelf (COTS) 3D printer systems. Specifically, E&G has developed a powdered PBX material, for use on powder bed fusion 3D printers, that matches the processability characteristics of an inert powder material that has already been qualified on these systems. PBF as a technology exceeds FDM in achievable part tolerances, strength of finished part, and allowable form factors. PBF is often more than an order of magnitude faster than FDM in part production.

Warfighter Value: E&G's development will ultimately result in decreased lead time of mission critical ordnance to the warfighter, through simplification and decentralization of manufacturing. In addition, the technology developed under this topic will enable energetics manufacturers to reduce cost and iterate more quickly on design of explosive structures to suit the needs of the warfighter.

WHEN

Contract Number: N68335-19-C-0169 **Ending on:** February 22, 2020

Milestone	Risk Level	Measure of Success	Ending TRL	Date
First production of a PBX feedstock powder	N/A	Particle morphology and energetic behavior met tartget goals.	2	December 2017
Processability validation on printer test beds	N/A	Small scale test object successfully printed and detonated.	3	March 2018
Scale up PBX batch from 50gto 1kg scale	Med	Pilot scale synthesis while maintaining chemical and physical properties of lab scale batches.	3	November 2019
If Option exercised, Test print of full structure in a commercial printer	High	Printed part is within dimensional specifications, and approaches molded/ cast part density.	5	October 2020
If Option exercised, Print model warhead or similar device	High	Matches performance specifications of tradditionally manufactured part	6	November 2021

HOW

Projected Business Model: E&G Associates intends to transition this technology by either licensing the technology to an existing energetic materials manufacturer or by producing the powder feedstock at E&G and providing the material to interested manufacturers of energetic components. E&G is preparing for the possibility of low rate initial production of the energetic feedstock in the event of successful Phase II RDT&E efforts, but is open to licencing the technology in the event that demand for the product exceeds our capability.

Company Objectives: E&G is currently seeking to identify other companies interested the energetic feedstock technology. This might include prime contractors or other companies in the business of manufacturing energetic components for DoD use. It is anticipated that the ability to 3D printer high explosive structures will be of interest to a number of RDT&E efforts within the Navy and the DoD as a whole, and would like to identify paths to provide this technology for wider use.

Potential Commercial Applications: E&G anticipates limited applications in civilian markets; however the feedstock development approach is likely useful in non-energetic applications. For example, if E&G PBX feedstock development approach were extended to produce a propellant material it could find commercial viability in markets such as gas generators or actuators.

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