#### Department of the Navy SBIR/STTR Transition Program

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SSP: 14 Nov 2018

## WHO

SYSCOM: SSP

Sponsoring Program: TRIDENT II (D5), ACAT I

Transition Target: TRIDENT II (D5), ACAT I

#### TPOC: SSP.SBIR@ssp.navy.mil

Other transition opportunities: Low cost and rapid manufacturing of refractory metal components for strategic missile post-boost propulsion systems, hot gas valves, manifolds, and other DoD refractory metal parts.

**Notes:** The image shows an "as deposited" Tantalum hemisphere with outer diameter of approximately 3.5" (89mm) produced using the EBAM process. Future adaptation to other refractory alloys of interest to the warfighter are planned. This SBIR has



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developed processes for deposition of refractory materials, demonstrated subscale article fabrication and is conducting design and analysis of relevant hot gas valve and manifold components to be built with advanced additive manufacturing methods leading to full-scale component prototypes.

#### Topic # N142-125 Affordable Manufacturing of Refractory Metal Components Sciaky, Inc.

### WHAT

**Operational Need and Improvement:** To develop and demonstrate advanced Additive Manufacturing (AM) techniques for lower-cost production of refractory metal components for Navy strategic missile postboost propulsion systems.

**Specifications Required:** SSP desires to reduce the cost and skill required to manufacture select refractory metal components through more efficient use of raw materials along with a reduction of machining, multiple setups, and labor hours.

**Technology Developed:** Sciaky developed Electron Beam Additive Manufacturing (EBAM) using an electron beam gun to deposit wire feedstock, layer by layer, until the near net shape preform is complete. Initial efforts targeted aerospace structures; this efficient in-vacuum process is well suited for reactive refractory metals. For many parts, EBAM will result in lower cost and faster lead times compared to legacy refractory component manufacturing methods. Sciaky demonstrated that a low cost substrate could be used to initiate EBAM deposition. Since all EBAM systems have 100% EB Welding capabilities, Sciaky also demonstrated welding EBAM preforms together.

**Warfighter Value:** EBAM processing has the potential to improve support of existing Trident II (D5) missile components and allow greater design and manufacturing choices for future missile programs, e.g., "light weighting", having better properties than existing material inputs. Potentially significant cost and lead time reductions can be accomplished requiring only some basic material inputs be maintained in stock. Compared with legacy production methods, material waste will also be reduced which is important as refractory materials are very expensive.

#### **WHEN**

# **Contract Number:** N00030-18-C-0226 **Ending on:** May 6, 2019

| Milestone   | Risk<br>Level | Measure of Success   | Ending<br>TRL | Date             |
|---|---------------|--|---------------|------------------|
| Phase I SBIR - EBAM<br>Affordable Manufacturing of<br>Refractory Metal Components | Low           | Key performance metric -<br>elevated temperature<br>mechanical properties excellent          | 4             | August 2016      |
| Phase I Option - EBAM<br>Refractory Materials -<br>Properties confirmed           | Low           | Elevated temperature<br>properties confirmed excellent,<br>Cost effective substrate verified | 4             | June 2017        |
| Phase II SBIR Design Review<br>Complete   | Low           | Sciaky, USN, and key industrial team members aligned   | 4             | December<br>2017 |
| Phase II SBIR Hot Gas Testing<br>and materials assessed                           | Med           | Verify we are meeting or exceeding design values?  | 5             | January 2019     |
| Phase II Demonstrator<br>Component Fabrication                                    | Med           | Does EBAM demonstrator meet geometry and metallurgical requirements?                         | 5             | May 2019         |

## HOW

**Projected Business Model:** Sciaky's current business model is to sell EBAM and Electron Beam Welding systems. Leading to the systems sales, Sciaky has developed the EBAM process technology, and we take on a wide range of critical EBAM development programs for both commercial and government programs. Our success on these development efforts leads directly to machine quoting and sales opportunities.

**Company Objectives:** The company objectives relating to this SBIR are to succeed through the process development with the refractory material EBAM process development to a point where we can sell EBAM systems into the supply chain, the end user / OEM, or both. It remains possible that one of our SBIR team members on this program; Lockheed Martin or ATI could recognize the value of EBAM processing and pursue a system for refractory materials.

**Potential Commercial Applications:** Refractory materials are utilized in a wide range of thermal barrier protection applications by several industries including rocket / missile / space propulsion, oil / gas, jet engine, etc. Additional refractory alloys are planned to be incorporated into the SBIR Phase II Option, and could open up other markets and opportunities.