Topic: N17B-T031

Directed Vapor Technologies International, Inc.

Materials Modeling Tool for Alloy Design to Streamline the Development of High Temperature, High-Entropy Alloys for Advanced Propulsion Systems

DVTI leads a team developing a property-oriented, materials modeling tool that enables rapid transition of high entropy alloys (HEAs) capable of withstanding high temperature turbine engine environments. Next generation engines will operate at temperatures exceeding the limits of today's nickel-based superalloys. HEAs meeting the baseline requirements were identified and screened. On-going work is enhancing the predictive capabilities for a high temperature oxidative environment. DVTI is a materials and manufacturing company that utilizes a novel vapor deposition process – directed vapor deposition (DVD) – to create advanced materials and functionally coated products. DVTI seeks to provide services to commercial partners for the development of novel alloy systems and expanding its coating services business segment, which utilizes DVD to apply high quality metal and ceramic coatings onto complexly shaped components.

Technology Category Alignment:

Aircraft Propulsion, Power and Thermal
Corrosion
Propulsion and Extreme Environments

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SYSCOM: NAVAIR
Contract: N68335-19-C-0198

Booth: 405
Room: FST at AIAA Aviation 2020

Department of the Navy SBIR/STTR Transition Program

Pending SYSCOM Review

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WHO

SYSCOM: NAVAIR

Sponsoring Program: JSF

Transition Target: Propulsion

TPOC:
(301)342-8011

Other transition opportunities: The technology developed will have broad applicability to defense applications seeking novel high performance alloys.

Source: Air Force Research Laboratory (VIRIN: 120106-F-ZU869-008)

WHAT

Operational Need and Improvement: The demand for high efficiency/high thrust gas turbine engines is driving the need for higher temperature capable alloys. Efforts to extend the operational envelop of nickel based superalloy blades are approaching their known limits. It is believed that high-entropy alloys are a potential solution. However, the complexity of such systems necessitates the development of an innovative modeling tool to rapidly identify and transition candidate high-entropy alloys.

Specifications Required: The Navy seeks a property-oriented design tool capable of identifying complex alloys that possess a high melting temperature (>1,600 °C); phase stability between 1,200-1,400 °C; and a density lower than current refractory metal alloys.

Technology Developed: A materials database, which operates within the Pandat (CompuTherm, LLC) computation engine, has been utilized to identify baseline high temperature alloys meeting the Navy's goals. Physical verification of the alloy performance is on-going, both in thin-film and bulk-alloy forms. The program will conclude with delivery of the design tool and bulk alloys samples of the most promising high-entropy alloy composition for demonstration and evaluation.

Warfighter Value: The modeling tool will streamline the development of advanced propulsion systems capable of producing increased thrust and withstanding harsher operating conditions, contributing to air superiority and increased time-on-wing for the warfighter.

WHEN

Contract Number: N68335-19-C-0198 **Ending on:** January 21, 2021

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Lab testing of coupons to validate initial modeling efforts	N/A	Performance of alloys aligns with predictions	3	September 2018
Thermo-mechanical testing of bulk alloy to verify model	Med	Performance aligns with predictions and desired operational envelope	4	July 2020
Initial alloy data compiled through direct specimen testing	Med	Performance aligns with predictions and desired operational envelope	5	January 2021
Comprehensive alloy data compiled through direct specimen testing	High	Performance aligns with predictions and desired operational envelope	5	July 2022
Representative test article(s) evaluated by OEM in simulated engine environment to validate modeling tool	High	Test article survives simulated operational environment	6	July 2023

HOW

Projected Business Model: Both the design tools and alloy compositions developed will be licensed to interested parties.
The design tools rely on the Pandat software produced and licensed by CompuTherm, from whom NAVAIR has negotiated non-exclusive, time-limited licensing under the subject contract. Similarly, other parties seeking to develop high entropy alloys will be able to license the databases and software resulting from this contract.
The alloy compositions developed will be separately licensable to turbine engine manufacturers and/or alloy manufacturing, casting, and forging companies.

Company Objectives: DVTI seeks to provide research services to commercial partners interested in the development of novel alloy systems. The Company is also interested in expanding its coating services business segment, which utilizes a unique vapor deposition process to apply high quality metal and ceramic coatings onto line-of-sight and non-line-of-sight components.

Potential Commercial Applications: The technology developed will have applicability to commercial aviation manufacturing firms and, more broadly, alloy manufacturers, casting, and forging companies seeking to develop high performance alloys.

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