Department of the Navy SBIR/STTR Transition Program

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Topic # N16A-T019
Thermal Barrier Coatings for Long Life in Marine Gas Turbine Engines
ReliaCoat Technologies LLC

WHO

SYSCOM: ONR

Sponsoring Program: ONR

Transition Target: Marine Gas Turbines

TPOC:
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Other transition opportunities:
Predictive Modelling for other thermal spray applications

U.S. Office of Naval Research image, available at http://www.navsea.navy.mil/Home/Warfare-Centers/NSWC-Philadelphia/What-We-Do/

WHAT

Operational Need and Improvement: Materials for current marine gas turbine engines were developed and tested during 1960-1990s to resist degradation from Type I hot corrosion (1600-1700ºF) and Type II hot corrosion (1250-1350ºF). This development for USN marine gas turbines produced the highly reliable marine gas turbines that exist today where engines are not operated at full power where there may be only occasional spikes to 1700ºF. Navy engines operating at less than full power mode allowed these hot section materials to exist for 20k hours or more before repair or replacement was required.

Specifications Required: The system will help to initiate correlations that should begin to formulate the ICME (integrated computational material engineering) model framework to promote long TBC life (goal: > 20K hours) and assist in maximizing corrosion and oxidation resistance by changes in coating chemistry and structure while not impacting fatigue, creep, or substrate strength of the substrate alloys. The ICME framework shall be further expanded to include compatibility of the TBC to different bond coats as well as further development, modification, and maturation of the ICME model.

Technology Developed: ReliaCoat Technologies, LLC developed an isothermal ICME model to predict coating properties with respect to process input variables. This model will be further developed to help predict TBC life >20K hours and assisting in maximizing corrosion and oxidation resistance. Sustained competitive advantage is provided as this technology allows users to understand actual coating life. Moreover, the ICME model can be utilized in other coating applications where difficult relationships between process variables and resultant properties exist.

Warfighter Value: This technology enables the end user to visualize how process input parameters effect the resultant coating properties. We are proposing to take this methodology one step further and link the actual processing conditions to coating life. This means that we will be able to predict which input variables will produce the desired coating for the future of engineered coatings, which will decrease experiments necessary to produce optimal coatings. This will also put process limits on what can be used for a production environment, with a high confidence level in quality.

WHEN

Contract Number: N68335-17-C-0530 **Ending on:** November 27, 2019

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Process ICME with process map and regression equations	Low	ICME prediction for process input variables	2	1st QTR FY19
Failure analysis of bond coat oxidation upon sea salt ingression	Low	Failure Analysis completed	3	1st QTR FY19
Demonstrate performance of ICME model	Med	ICME Model demonstrated	4	3rd QTR FY19
Demonstrate prototype IntelliSpray Dashboard	Med	ICME inserted into relevant parametric	5	1st QTR FY20
Component geometry effect on coating performance	High	Performance of component passes tests	6	3rd QTR FY20

HOW

Projected Business Model: Our business model is to primarily direct sell software and knowledge of ICME modelling for a variety of coating material systems. Alternatively, licensing of the developed software will be considered to integrate into current in-process and post-process coating property measurement systems.

Company Objectives: We anticipate the Navy SBIR/STTR Transition Program (STP) Forum will solidify connections with Government and industry to promote our ICME methodology that was applied to the coating system needed to propel the Navy into future capabilities. With this demonstration, our technology will be realized and deployed to legacy coating systems for quality control and fast design of experiments. Our short term objective is to earn and solidify a Phase III in which we will look to apply our current technology to actual components in the field. This will support concrete evidence that ICME can be used for quantifying how process input variable effect the outcome of a coating material system.

Potential Commercial Applications: This technology would be applicable to other commercial industries that utilize thermal spray for coating applications. The ICME methodology would grant these companies the same capabilities in determining how process input variables effect their coating performance. Additionally, it could be used as a tool for process control where the commercial company would be able to see the upper and lower limits of the process to achieve the desired coating properties.

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