Department of the Navy SBIR/STTR Transition Program

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NAVSEA #2021-0435

Topic # N18A-T010

Multi-Modal Sensing of Sensitization and Stress Corrosion Cracking Susceptibility in AA5xxx Alloys

Luna Innovations Incorporated

WHO

SYSCOM: NAVSEA

Sponsoring Program:

Transition Target: PMA-501 (Littoral Combat Ships), PMA-505 (LCS Fleet Introduction and Sustainment)

TPOC:
(301)227-5078

Other transition opportunities: Technology developed under this topic may be applicable to aluminum platforms used by other services.

https://www.navsea.navy.mil/Media/Images/igphoto/2001271115/

WHAT

Operational Need and Improvement: High magnesium 5xxx aluminum alloys enable the Navy to build lighter, faster ships due to excellent specific strength, corrosion resistance, and as-welded strength. However, these alloys sensitize in their service environment when Mg comes out of solution to form a network of beta-phase precipitates along the grain boundaries, creating a pathway for stress corrosion cracking (SCC). Aluminum sensitization can increase the total ownership cost of a ship. The ability to predict sensitization and stress corrosion cracking onboard current and future aluminum ships is needed. Available technologies are not predictive and/or are not able to access confined spaces associated with internal structures. The Navy needs a robust SCC prediction tools for commercially available 5xxx series aluminum alloys.

Specifications Required: - Nondestructive
- Man-portable per MIL-STD-1472H
- Compact enough to fit through standard Navy watertight doors and inspect areas 12" in diameter
- Rapid results with no more than 1hr cycle time from setup to results output

Technology Developed: Luna developed a Multimodal Sensitization and SCC Analysis (M2SA) tool that provides nondestructive evaluation of current levels of sensitization and material-specific microstructural conditions for prediction of future degradation. The M2SA tool leverages rich data sets gathered through multimodal sensing as input into integrated machine learning models trained to provide actionable information about whether repair is required.

Warfighter Value: The portability, non-destructive nature, and intelligence of the M2SA system all improve upon incumbent solutions, allowing assessment of interior structures and improved prediction of future risk. Specific use cases include:
- Quality control analysis of ship construction materials will reduce future maintenance costs
- Improved damage and degradation risk assessments from shipboard inspections will improve maintenance planning for improved mission readiness
- Process optimization with feedback from the M2SA system could help material suppliers reduce production of problematic materials

WHEN

Contract Number: N68335-20-C-0322   **Ending on:** March 3, 2022

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Demonstrate individual sensing modes on lab specimens	N/A	Validation of operating principles	3	December 2019
Complete portable prototype and integrated predictive algorithms	Low	Demonstrate conformance to design constraints	4	December 2021
Evaluate performance and conduct shipboard demonstration	Med	Verify device function in Navy environment	6	August 2022
Document plans for qualification and transition of technology	Low	Prepare for technology qualification	6	March 2023
Perform Reliability Assessment and Environmental Testing	Med	Demonstrated performance	8	December 2025

HOW

Projected Business Model: Luna's development of the M2SA system is a collaboration with Electrawatch LLC, a subsidiary of Austal USA and manufacturer of the incumbent DoS Probe technology. Luna intends to develop the M2SA technology and to license it to Electrawatch for sensitization assessment at repair yards.

Company Objectives: Luna's objective is to establish contact and to identify a transition pathway for the M2SA technology. Contacts of interest include those within PMA 505, PMA 500. These contacts will be critical to gaining access to representative materials for reliability assessment, for identifying specific environmental tests needed for system qualification, and for serving as the approval authority to document conformance to requirements.

Potential Commercial Applications: The ability to characterize material microstructure and to relate to material performance in service is novel and valuable to a variety of industries including the aerospace and automotive industries. In addition, use of the M2SA system by material suppliers could enable process optimization and improvement of material outcomes.

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