Department of the Navy SBIR/STTR Transition Program

NAVAIR 2020-726

Topic # N182-105

Internal Antireflection Coatings for Aerodynamic Missile Domes

Surface Optics Corporation

WHO

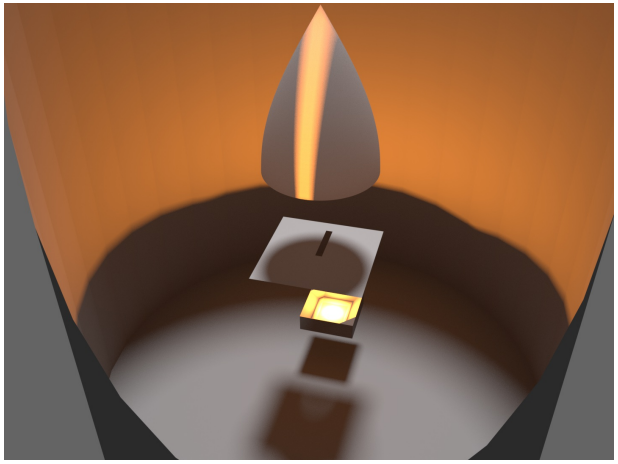
SYSCOM: NAVAIR

Sponsoring Program: PMA-259

Transition Target: Future Air-to-Air Weapons Systems

TPOC:
(760)939-1649

Other transition opportunities: Future Unmanned Combat Air Vehicles (PMA-268), Future Hypersonic Weapons Systems, Conformal Sensor/View windows for F-35 and Naval Special Warfare. Surface Optics Corporation (SOC) is a vertically integrated optoelectronic engineering company that provides optical coating services and manufactures hyperspectral imaging and metrology hardware for Department of Defense, Aerospace, and Industry.



Internal Antireflection Coating Process for IR Missile Dome. Copyright 2020 (Surface Optics Corp)

Notes: SOC is backed by 40 years of innovation in advanced optical coatings, spectral sensor design and hyperspectral imaging systems. SOC optical coatings are on the primary mirror of NASA's Kepler Space Telescope, the SEIS seismic module of the NASA/JPL Mars Insight Lander, as well as antenna and other components of commercial communication satellites. SOC reflectometers validate the optical performance of solar arrays and stealth aircraft. SOC hyperspectral imagers provide standoff detection of battlefield explosives, and currently in partnership with BP and Lockheed, monitor the combustion products oil refinery flares in real time to limit methane emissions.

WHAT

Operational Need and Improvement: Future high-speed missiles will use aerodynamic infrared (IR) seeker domes to reduce drag and permit increased field of regard for the seeker. These ogive domes require optical antireflection coatings to reduce unwanted reflections that limit seeker performance. Conventional optical coating methods are designed to create a uniform reflectance profile across a curved surface, but aerodynamic ogive domes require a variable reflectance profile to accommodate sensor view angles. Surface Optics Corp (SOC) has developed an improved deposition process to apply view-angle optimized IR coatings on the inside of optical ceramic missile domes, combined with IR imaging metrology to measure coating performance. This approach is readily adaptable to other applications like conformal sensor windows and uses proven materials and optical design technology that can transition directly to high rate production.

Specifications Required: A high-temperature stable antireflection coating is required that significantly reduces average polarized reflectance of IR Optical Ceramic at wavelengths between 3-5 microns and extreme incidence angles. Reflectance at a wavelength of 4 microns must be <1% at normal incidence, <3% at 55 degrees, and <5% at 60 degrees.

Technology Developed: SOC's enhanced process uses variable focused physical vapor deposition (PVD) to produce a controlled coating thickness profile across the part surface. The coating design is matched at each point of the dome or window geometry to maximize antireflection across a broad range of sensor view angles. The current application is for IR antireflection coatings but is adaptable to produce tailored reflectance in any spectral region.

Warfighter Value: Antireflection coatings increase missile seeker performance by suppressing stray light reflection and improving transparency of the seeker dome. High-temperature stable antireflection coatings improve the mission success of missile domes and sensor windows that operate in extreme environments.

WHEN

Contract Number: N68936-20-C-0028 **Ending on:** February 4, 2022

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Optimized Antireflection (AR) coating design	Low	Heat-stable AR coatings on dome material coupons	4	October 2020
Identify dome coating process parameter space	Med	Controlled AR coating profile in dome test fixture	4	May 2021
Deliverable AR coated coupons for missile dome geometry	Med	AR coated test coupons meet optical and quality specs	4	August 2021
Full AR coated missile dome (Phase II Option)	Med	AR coated dome meets optical and quality specs	4	February 2022

HOW

Projected Business Model: Surface Optics Corp plans to offer optical coating services for complex parts, acting as a value-added manufacturing partner to U.S. Defense Prime Contractors and OEM suppliers. SOC's enhanced coating technology leverages existing coating lines that will support automated processing of multiple dome or window components, or large single windows up to 3 meters diameter. SOC-manufactured spectral imagers will support process validation.

Company Objectives: Surface Optics Corp seeks the following: 1) Vendor relationships with U.S. Defense Prime Contractors and OEM suppliers that require optical coatings for domes and windows, 2) Phase III funding partners for continued process development in advance of production, 3) Application partners for IR domes and windows, transparent armor, or other DoD and commercial applications that require application of spectrally tailored optical coatings

Potential Commercial Applications: The ability to coat a small spherical lens uniformly and economically would be an important commercial application. Coating application technology developed in this SBIR effort has potential in the application of heat-resistant coatings where durability and stability at high temperature is required.

Commercial applications include: (1) Medical-lighting systems that use hot mirrors, cold mirrors, and ultraviolet-blocking filters that need to withstand high temperature and high ultraviolet flux. Coatings that have better heat and ultraviolet radiation resistance and that could be deposited uniformly onto the interior and exterior of the bulbs would extend the lifetimes of these medical-lighting systems. (2) Ball lenses for fiber-optic interconnects that are used in the telecommunications industry—antireflection coating uniformity is an issue on these types of lenses. (3) Products such as solar reflectors, infrared- and ultraviolet-curing filters, optical-projection systems, and satellite and space-based optical systems that are subjected to high thermal loads.

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