Department of the Navy SBIR/STTR Transition Program

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NAVSEA #2021-0457

Topic # N171-045

Hydrophobic and wide-angle anti-reflecting nanostructured coatings on hemispherical domes and windows; including high-refractive index surfaces

HighRI Optics, Inc.

WHO

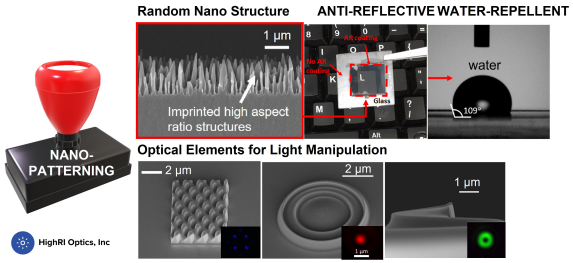
SYSCOM: NAVSEA

Sponsoring Program: Navy Integrated Submarine Imaging Systems

Transition Target: Optical Systems

TPOC:
(401) 832-7032

Other transition opportunities: HighRI Optics, Inc seeks to explore other DoD, DoN, and commercial applications where broadband and wide-angle antireflection (AR) nano surface coating can be utilized. The surface coating technology is applicable beyond the AR nanostructures and can be used to pattern a variety of optical structures (lens, diffractive elements, etc.) to manipulate light.



WHAT

Operational Need and Improvement: Random Anti-Reflective (RAR) surface coating provides broadband antireflection on a wide-angle and water repellency for superior visibility of the imaging sensors. All of which will meet or exceeds all specified mission criteria.

Specifications Required: HighRI Optics's durable AR surface coating can minimize light reflection and sun-glint. The AR structures are designed to work over a broad light spectrum and wide angles. The AR structures can be applied to flat, curved, and hemispherical optics on both internal and external window surface to provide excellent optical properties. The finished AR coating will be durable to maintain both the antireflection and water repellency properties under harsh environmental conditions.

Technology Developed: HighRI Optics developed proprietary nanopatterning technology using nanoimprint lithography to pattern RAR nanostructures on various optical window materials and shapes. The technology uses a replication (stamping) method, which is reproducible and cost-effective. Nanopatterning technology can be used to pattern various nanostructures, including the RAR nanostructures and designed optical structures, such as lens and diffractive optical elements, to meet specific imaging needs. The performance advantages of the technology include: precise light manipulation, cost-effectiveness during re-application, reproducibility, corrosion and biofouling resistance, wide-angle anti-glaring, and self-cleaning.

Warfighter Value: The optical performance of RAR nanostructures has been shown to be superior to the conventional multi-layer antireflection approach enabling wide-angle and broadband antireflection properties. The surface treatment adds water repellency and corrosion resistance. The AR window surface has suppressed light reflection over a wide-angle. In summary, the technology provides considerable value to the warfighter, including 1) anti-glaring and hazing, 2) improved signal detection, 3) self-cleaning property from (super) hydrophobicity, and 4) reduction in maintenance (i.e., re-application) cost.

WHEN

Contract Number: N68335-21-C-0210 **Ending on:** March 5, 2022

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Long duration environmental stability and reliability (small scale window – fused silica)	Med	Maintain optical properties and hydrophobicity. Resistant to biofouling.	5	December 2021
Military-spec evaluation of full-scale AR coated windows (small scale windows – fused silica)	Med	Passing the test	5	January 2022
Design / Assemble Full-scale nanoimprinter tool (If Option I is exercised)	Low	Successful Patterning on the full-scale windows	6	August 2022
Military-spec evaluation of full-scale AR coated windows (If Option II is exercised)	Low	Passing the test	6	June 2023
Long-term environmental durability (full-scale AR coated windows on the submarine)	Med	Maintain Optical Properties and hydrophobicity	6	December 2023
Cleaning / Maintenance Process Establishment (if Option II is excercised)	Low	Process are tested by NAVY personnel and varified	6	December 2023

HOW

Projected Business Model: Primary business model is to supply AR finished optical windows to the customer with a sufficient volume for program applications. The customer will provide the specifications. HighRI sources the optical windows.

Secondary business model is to transfer the technology to high-volume manufacturing contractors utilizing the infrastructure and compliance. HighRI team will provide training and extended-term supervision of manufacturing until it becomes fully established and robust.

Third business model is for low-cost industrial and consumer markets. The low-loss, broadband, wide-angle, antifogging, and water-resistant nanostructured coatings can experience explosive market needs for non-military applications. HighRI will seek to transition to high-volume production in cooperation with large companies that are suppliers of similar parts to the broad industrial and consumer market.

Company Objectives: HighRI Optics's mission is to "enable advanced photonic applications" by the development of break-through nanofabrication technology and optical materials. We have already licensed novel optical materials to a multibillion-dollar company. HighRI Optics seeks opportunities with DoD and commercial applications where the superior AR properties, abrasion-resistant and hydrophobic surface can be utilized.

Potential Commercial Applications: HighRI's nanopatterning technology and optical materials find numerous applications in consumer applications. Antireflection is an essential part of the display and sensor technology for optimum performance. Beyond AR application, HighRI's technology is applicable for patterning many other optical structures, including lens and discrete optical elements, on a variety of surfaces, including high-refractive-index windows, fiber facets, and plastic surfaces. Consumer electronic products demand a thinner and lighter footprint with the high optical performance. HighRI's nanopatterning of optical elements, including antireflection, would be the key enabler of such technology.

Contact: Keiko Munechika, CEO, HighRI Optics, Inc.
km@highrioptics.com 360 402 4112