Department of the Navy SBIR/STTR Transition Program

Topic # N17A-T020
Phase-Change Materials for Tunable Infrared Devices
Plasmonics Inc.

WHO

SYSCOM: ONR

Sponsoring Program: ONR

Transition Target: Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR)

TPOC:
Dr. Brian Bennett
brian.r.bennett@navy.mil

Other transition opportunities: We see multiple transition options for this technology, with the initial focus on use as an infrared (IR) Free-Space Optical Communication (FSOC) modulator for secure communications. The modulator can also be deployed as part of a thermal transponder for target identification, as a dynamic beam deflector or as a dynamic polarizer for target classification.

Photo courtesy of US Marine Corps, 180817-M-HF454-0101.JPG

WHAT

Operational Need and Improvement: There is a critical need for the development of dynamic IR materials that can be used to form device level components and systems necessary for mid- to long-wave IR (3-12 µm) applications. Communication systems utilizing the thermal IR band have several advantages over existing optical systems including higher transmission through haze and fog and improved covertness. These benefits make the proposed technology ideal for use in ship-to-shore or ship to unmanned aerial system communication systems when existing communication channels are degraded. Developing materials that are responsive, dynamic (spectrally tunable and externally controllable), affordable, and high speed are key operational factors.

Specifications Required: The goal of this project is to design and fabricate tunable elements with the following specifications:

- Volume less than 20 cubic centimeters
- At least four simultaneous channels in the 3-12 um range
- Field of view of at least +/- 60 degrees

Technology Developed: Under this program, Plasmonics Inc has developed a new class of Spatial Light Modulators (SLMs) utilizing phase-change materials (PCMs). Controlling the optical property of PCM's is achieved by electrical biasing and results from the re-ordering of the material's crystal structure. Coupling these materials to an IR coating makes it possible to engineer an active surface with a wide range of optical behaviors including dynamic amplitude, polarization, and directionality. These behaviors can be leveraged to assemble various compact, dynamic optical elements such as filters, polarizers, beamsteerers, and absorbers.

Warfighter Value: Dominance of the electromagnetic (EM) spectrum is critical for DoD. Emerging communication technologies that operate within untapped portions of the spectrum, such as the thermal IR, will shape the battlespace and disrupt the adversaries ability to do the same.

WHEN

Contract Number: N68335-18-C-0659 **Ending on:** September 24, 2020

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Fabrication of Single Element SLM	Med	Demonstrate the dynamic properties of the PCMs. Metrics to be validated include bit rate, field-of-view, and dynamic contrast.	3	4th QTR FY19
Fabrication of Multiple Element SLM	Low	Demonstrate multiple SLM pixel functioning independently, without impact on overall performance. Multiple pixels will increase aperture size and allow for multi-channel operation.	4	4th QTR FY20
CMOS Control Board Integration (in Phase II Option)	Med	Complete the packaging of the SLM by integrating a CMOS control board. At this stage, full fabrication of the SLM array will have been demonstrated.	5	4th QTR FY22
Field-Relevant Test and Integration (During Phase III)	Med	Demonstrate the use of the SLM within a platform, including relevant sources and detectors. Baseline performance will be demonstrated in a relevant environment.	6	4th QTR FY23

HOW

Projected Business Model: Plasmonics Inc intends to manufacture and sell the modulator developed under this STTR. However, we recognize the value of partnering with an established DoD supplier to ensure quality and to address the volume needs of the DoD. Existing relationships with key industry players will facilitate prototype testing, high volume production, and acquisition. We would also note that development of the technology has been done to minimize fabrication cost and to support ease of transition to an established DoD contractor. All of the processes used are CMOS compatible and utilize affordable deposition techniques, such as sputtering. Plasmonics Inc is also actively seeking partnerships with larger DoD integrators to integrate the SLM within existing platforms and systems.

Company Objectives: Plasmonics Inc envisions the development of the IR SLMs as the initial step towards an expanded product line based around dynamic thermal IR optical elements. Mature, non-mechanical, dynamic optical elements for the thermal IR do not currently exist and Plasmonics Inc seeks to become the industry leader in this area.

Potential Commercial Applications: With the emergence of affordable of thermal IR sources and cameras, there exists a significantly greater demand for IR optical elements and systems within the civilian marketplace. IR FSOC systems are a promising alternative to traditional RF communication networks due to overburdening of the US RF spectrum and the fact that optical communication channels do not require licensing from the FCC. FSOC systems are also ideal for situations where high security, quick setup, and low power consumption are critical. Potential applications include last-mile access when physical network connections are not possible, temporary networks for disaster recovery, air-to-air communication (including satellites), and high-security communication networks such as stock trading. Unlike prior FSOC designs, the system under development by Plasmonics Inc provides improved operational range and reduced signal degradation during inclement weather, which are currently the largest limiting factors of competitor platforms.

Contact: James Ginn, President/CEO
james.ginn@plasmonics-inc.com 407-574-3107