

Topic: N132-125

Technology Assessment & Transfer, Inc.

Scalable High Strength Spinel Reconnaissance Window Manufacturing

The company is developing strengthened Magnesium Aluminate Spinel ($MgAl_2O_4$) for transparent optical sensor windows. The two primary objectives in this project are scaling up size and strength of Spinel windows. This enables use of advanced sensor systems operating from the UV through the mid-wave infrared (MWIR). It improves situational awareness, enhances targeting and intelligence, surveillance and reconnaissance (ISR) operations, and enables multiple sensor systems to operate behind a single protective window. Spinel reduces the total cost of ownership through improving erosion resistance, increasing protection against runway debris, reducing replacement, and improving preventative maintenance operations. Spinel has other applications in transparent armor, missile domes, viewports, and potentially as solid state laser gain media and scintillators for medical, high energy physics, and detection of special nuclear materials.

Technology Category Alignment:

Satellite Communications (SATCOM)

Robotics/Automated Material Handling Equipment

Shipyards/Shipbuilding

Supply; Storage

Satellite Communications (SATCOM)

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Supply; Storage

Supply; Storage

Satellite Communications (SATCOM)

Shipyards/Shipbuilding

Robotics/Automated Material Handling Equipment

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Robotics/Automated Material Handling Equipment

Robotics/Automated Material Handling Equipment

Protection, Sustainment, and Warfighter Performance

Medical Chem-Bio Defense

Military Infectious Diseases

Propulsion and Extreme Environments

Fixed Wing Vehicles (includes UAS)

Survivability

Maintainability/Sustainability

Unmanned Ground and Sea Vehicles

Corrosion

Advanced Computing/Software Development

Networks and Communications

Modular/Open/Reconfigurable Architectures

RF Components for sensing, transmission and communication

Electronics Integration

Broadband/Multispectral Components and Systems

Sensors, Electronics and Photonics

Radio Frequency (RF) (non-EW)

Survivability

Broadband/Multispectral Components and Systems

RF Components for sensing, transmission and communication

Radio Frequency (RF) (non-EW)

Networks and Communications

Guidance, Navigation & Control (GN&C) and Data Links

RF Components for sensing, transmission and communication
Networks and Communications
Cognitive/Adaptive Capabilities
Preemptive/Proactive Effects
Broadband/Multispectral Components and Systems
Advanced Computing/Software Development
Networks and Communications
Personalized Assessment, Education, and Training
System Interfaces & Cognitive Processes
Aircraft Propulsion, Power and Thermal
Modeling, Simulation & Test Infrastructure
Rotary Wing Vehicles
Fixed Wing Vehicles (includes UAS)
Fixed Wing Vehicles (includes UAS)
Acoustic, Seismic and Magnetic
Rotary Wing Vehicles
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Mobility
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Advanced Computing/Software Development
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Aircraft Propulsion, Power and Thermal
Power Generation/Energy Conversion
High Energy Lasers (HEL)

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Protection, Sustainment, and Warfighter Performance

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Assuring Effective Missions
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EO/IR Components for sensing, transmission and communication

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Fixed Wing Vehicles (includes UAS)
Aircraft Propulsion, Power and Thermal
Rotary Wing Vehicles
EO/IR Components for sensing, transmission and communication
Satellite Communications (SATCOM)
Networks and Communications
Trust Foundations
Electro-Optical/Infrared (EO/IR)
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Maintainability/Sustainability
Modularity
Survivability
Electro-Optical/Infrared (EO/IR)
Sensors, Electronics and Photonics
EO/IR Components for sensing, transmission and communication
RF Components for sensing, transmission and communication
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Clinical & Rehabilitative Medicine
Combat Casualty Care
Medical Chem-Bio Defense
Energy storage
Protection, Sustainment, and Warfighter Performance
Human Computer Interfaces (HCI) for Decision Making
Synthesis/Analytics/Decision Tools
Undersea Weapons
Human Computer Interfaces (HCI) for Decision Making
Information Collection/Management

Synthesis/Analytics/Decision Tools
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Manufacturing Technology for Affordability
Power and Energy
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Synthesis/Analytics/Decision Tools
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Trust Foundations
Integrating Architecture and Capability Demonstrations
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Fixed Wing Vehicles (includes UAS)
Rotary Wing Vehicles
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Propulsion
Protection, Sustainment, and Warfighter Performance
Individual Warfighter
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Modeling, Simulation & Test Infrastructure

Fixed Wing Vehicles (includes UAS)
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EO/IR Components for sensing, transmission and communication
RF Components for sensing, transmission and communication
Fixed Wing Vehicles (includes UAS)
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Synthesis/Analytics/Decision Tools
Electromechanical conversion
Energy storage
Power Control and Distribution
Power Generation/Energy Conversion
Electronics Integration
Energy storage
Power Control and Distribution
Power Generation/Energy Conversion
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Fixed Wing Vehicles (includes UAS)
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Energy storage
Power Generation/Energy Conversion
Unmanned Ground and Sea Vehicles
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Energy storage
Power Control and Distribution
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Thermal Transport and Control
Protection, Sustainment, and Warfighter Performance
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EO/IR Components for sensing, transmission and communication
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RF Components for sensing, transmission and communication
EO/IR Components for sensing, transmission and communication
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Design and Integration
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Networks and Communications
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RF Components for sensing, transmission and communication
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Design and Integration
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Structures and Protection
Aircraft Propulsion, Power and Thermal
Corrosion
Propulsion and Extreme Environments

Readiness

Sensors, Electronics and Photonics

Structures and Protection

Electronics Integration

Networks and Communications

None

None

None

None

None

None

None

None

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None

Department of the Navy SBIR/STTR Transition Program

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Topic # N132-125

Scalable High Strength Spinel Reconnaissance Window Manufacturing Technology Assessment & Transfer, Inc.

WHO

SYSCOM: NSMA

Sponsoring Program: Program Executive Office for Unmanned Aviation and Strike Weapons [PEO(U&W)] under NAVAIR

Transition Target: Unmanned Carrier-Launched Airborne Surveillance and Strike (UCLASS) program within the Unmanned Combat Air System Program Office (PMA-268)

TPOC:
(760)939-1649

Other transition opportunities: The DDG-1000 Zumwalt-class destroyers require large area, planar (flat) windows to protect an advanced camera system, and is a near-term opportunity for Spinel windows.



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WHAT

Operational Need and Improvement: Sophisticated airborne sensor systems require long-term protective shielding in order to avoid damage from runway debris, sand and rain erosion, in-flight impact events, corrosion, and other unforeseen contacts, without sacrificing sensor efficiency. A large-area Spinel window protecting an array of various sensors (optical through mid-wave IR) provides increased situational awareness for drone operators through the larger usable aperture space available to the multiple sensor systems, while providing the long-term protective shielding needed.

Specifications Required: At this time, UCLASS system specifications have not been finalized. However, under this SBIR effort, TA&T is targeting a strength increase of 100% in large area Spinel, while maintaining the high optical properties from the visible into midwave-IR wavelengths. The size required is on the same order of magnitude needed for the DDG-1000 Destroyer Sensor Suite windows.

Technology Developed: Spinel has been under research and development by TA&T and others for many years, and has been commercialized in small and medium-scale sizes (up to 300 square inches in area). The two primary objectives in this project are scaling up Spinel windows to sizes suitable for the UCLASS application and increasing the strength of full-sized windows so they're good.

Warfighter Value: The use of strengthened Magnesium Aluminate Spinel as transparent optical sensor windows enables use of the most advanced sensor systems operating out to the mid-wave infrared (MWIR). This will improve situational awareness, enhance targeting and ISR operations, and enable multiple sensor systems to operate behind one protective window. Strengthened Spinel reduces the total cost of ownership of the UCLASS system through improved erosion resistance of the window, increased protection against runway debris, and a reduction in preventative maintenance operations.

WHEN

Contract Number: N68936-15-C-0020 **Ending on:** May 18, 2017

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Demonstrate strength increase in 38 mm (~1.5 in) Spinel samples	N/A	Biaxial flexure strength measurements meeting target	4	August 2015
Demonstrate strength increase in 101 mm (~4 in) Spinel samples	Med	Biaxial flexure strength measurements meeting target	4	February 2016
Demonstrate strength increase in representative thick Spinel samples	Med	Biaxial flexure strength measurements meeting target	4	August 2016
Demonstrate strength increase in full size Spinel plate	Med	Biaxial flexure strength measurements meeting target; full size window fabrication	5	April 2017

HOW

Projected Business Model: Currently, TA&T intends to control manufacturing of the large area, conformal sensor windows for UCLASS applications. TA&T has experience in manufacturing and selling high-quality sensor windows for government, military, and commercial applications, and is fully prepared for further orders. TA&T has experience licensing technologies, and is willing to undertake this business model as well.

Company Objectives: TA&T is seeking improved coordination with DoD decision-makers and stakeholders and early coordination with prime contractors or system integrators to develop requirements for sensor or armor applications for which Spinel would be an ideal candidate material. TA&T is also seeking new applications for Spinel and its other technologies (notably, in 3D Ceramic Printing technology)

Potential Commercial Applications: Magnesium Aluminate Spinel has other current applications in transparent armor, missile domes, viewports, and experimental applications as solid state laser gain media and scintillators. A strengthened, large area Spinel plate will enable scale up of transparent armor into larger windows (e.g. windshields, building architectures) and drive cost reduction for smaller components and complex shapes.

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