

# Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2018-656

Topic # N152-104

Manufacturing Near-Net-Shape Conformal Electro-optic Sensor Window Blanks from

Spinel

CeraNova Corporation

## WHO

**SYSCOM:** NSMA

**Sponsoring Program:** PMA-268

**Transition Target:** Platforms requiring conformal sensor windows

**TPOC:**  
(760)939-1649

**Other transition opportunities:** advanced unmanned and fighter aircraft, rotorcraft windows

**Notes:** Electro-optic sensor windows that conform to the aircraft shape allow for a large sensor angle of regard and are desirable for future air platforms, both fixed wing and rotorcraft, manned and unmanned.

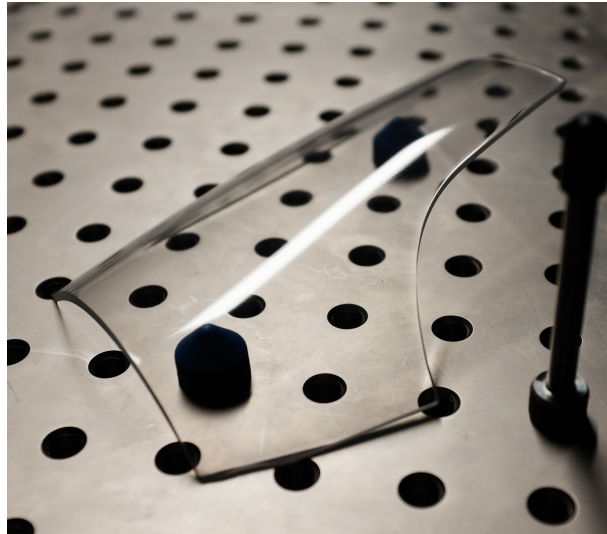


Image courtesy of J. Beverage, Arizona Optical Systems.

## WHAT

**Operational Need and Improvement:** Electro-optic sensor windows that conform to an aircraft's surface allow a large sensor angle of regard with no impact on aerodynamic performance. The size and curvature of present conformal windows are limited by the availability of planar blanks. Near-net shape forming enables more complex shapes (i.e., little or no symmetry) with increased curvature or "sag." Spinel is multi-spectral (high in-line transmission 200 - 5000nm) and is a more durable alternative to zinc sulfide.

**Specifications Required:** Produce two fully dense spinel conformal window blanks with minimum 16 x 16 inch footprint, 6 inches sag and 1 inch thickness. Demonstration shape may be a toroid or other freeform shape. Transmission within 4 pct of the theoretical value for spinel at 630nm wavelength, and within 2 pct of the theoretical value at 4000nm wavelength. Material strength greater than 200 MPa as measured by ring-on-ring flexure testing.

**Technology Developed:** Material compositions, processing methodologies, and performance improvement of transparent spinel, including conformal shapes, large flat panels, and ballistic test articles. Optical quality, high strength transparent spinel produced using proprietary processes enables near-net shape forming. Process is scalable for varying shapes, sizes, geometries, thicknesses. High in-line transmission (within 2 pct of theoretical) from UV through MWIR. Average strength approaches 400 MPa (2-3 times higher than other spinels). High strength at elevated temperature (up to 1000 deg C) gives improved thermal shock resistance. Demonstration conformal windows produced and polished. Scale up of large flat panels underway. Spinel tiles (4 x 4 inches) for ballistic testing in Q4 2018.

**Warfighter Value:** High speed aircraft and weapons are exposed to extreme mechanical and thermal stresses. Sensor windows must operate in this environment and maintain the optical performance required for target recognition and engagement. A durable ceramic window of CeraNova transparent, high-strength spinel will have the optical, mechanical, and thermal properties necessary to protect sensor system functionality, improve mission success, and increase warfighter survivability.

## WHEN

**Contract Number:** N68936-17-C-0040 **Ending on:** May 11, 2019

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Two conformal window blanks 6x6 inches with 3 inches of sag	Med	Fully dense, transparent window blank	3	December 2016
Demonstrate high in-line transmission	Low	Transmission within 4 pct of theoretical at 630nm and within 2 pct of theoretical at 4000nm	3	December 2016
Two crack-free, fully dense window blanks 16x16 inch footprint, 6 inches sag	Med	Fully dense, crack free window blanks	3	May 2019
Demonstrate high transmission and high strength on parts cut from conformal blanks	Med	Transmission within 4 pct of theoretical, strength greater than 400 MPa	3	May 2019
If Option exercised, two additional conformal window blanks incorporating design changes and process improvements	Med	Fully dense, transparent window blanks	4	November 2019

## HOW

**Projected Business Model:** CeraNova will manufacture conformal windows for direct sales to U.S. defense contractors. The company receives direct funding from Prime Contractors to develop parts and supply prototypes for DoD platforms (current and future) and sensor window applications. CeraNova actively seeks commercial, non-DoD applications for its materials and technologies. Our proprietary processing produces enhanced properties and superior performance compared to competing materials. As we move towards prototype production and LRIP, we are expanding our capabilities and manufacturing capacity through equipment investment, improved process control, quality management systems, and increased vertical integration including characterization and test capabilities. CeraNova is ISO 9001 certified and NIST 800-171 compliant.

**Company Objectives:** CeraNova specializes in process and product development of innovative, advanced ceramic materials. We provide our customers with the highest quality products, engineering expertise, service, and innovative technical solutions based on the latest ceramic technology advances. We actively seek application partners and commercialization opportunities for transitioning our technology developments to prototype and pilot-scale manufacturing.

**Potential Commercial Applications:** Large aspheric optics, high index lenses, drone/UAV conformal sensor windows, transparent armor, protective screens for electronic devices, high intensity lamps/LEDs, industrial process windows for high temperature and highly corrosive environments. Opportunities for extremely hard, non-optical ceramics that can be shaped into complex geometries, finished to precise dimensional tolerances, and polished to optical grade surface specifications include medical/dental prosthetics, solar concentrators, and commercial/industrial products for high wear or high abrasion/erosion resistance.

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