

Topic: N102-163

CeraNova Corporation

High Strength, Optical Quality Spinel

CeraNova's proprietary process for transparent spinel enables net-shape forming and densification at lower temperature without sintering aids. The resulting fine grained ($< 10\mu\text{m}$) microstructure demonstrates high transmission (visible through MWIR) and mechanical strength ($>300\text{MPa}$) two to three times higher than conventional large grain transparent spinel. CeraNova prototype windows (275mm square) show high transmission and low scatter. Processing of larger flat panels and curved shapes with significant sag is underway. Defense applications include large reconnaissance windows for aircraft and ships, smaller flat and curved windows for IR and laser countermeasure systems, and transparent armor. CeraNova specializes in process and product development of innovative, high technology ceramic materials. Application partners and commercialization opportunities are sought as the company transitions from technology development to prototype and pilot-scale manufacturing.

Technology Category Alignment:

Air Platforms

Broadband/Multispectral Components and Systems

Sensors, Electronics and Photonics

Structures and Protection

Electro-Optical/Infrared (EO/IR)

Contact:

Marina R. Pascucci, Ph.D.

mpascucci@ceranova.com

(508) 460-0300

<http://ceranova.com>

SYSKOM: NSMA

Contract: N68335-16-C-0131

 Corporate Brochure: https://navystp.com/vtm/open_file?type=brochure&id=N68335-16-C-0131

Department of the Navy SBIR/STTR Transition Program

Distribution Statement A: Approved for public release, distribution is unlimited
2016-737

Topic # N102-163

High Strength, Optical Quality Spinel
CeraNova Corporation

WHO

SYSCOM: NSMA

Sponsoring Program: PEO U&W

Transition Target: Reconnaissance windows for aircraft and ships.

TPOC:

(760)939-7324

Other transition opportunities: Replacement for Cleartran (ZnS) in aircraft sensor window applications. Other defense applications where a broad transmission window (visible through MWIR) is needed for electro-optical sensor suite protection.



Copyright 2015 CeraNova Corporation

WHAT

Operational Need and Improvement: Spinel is an excellent candidate for infrared window and transparent armor applications due to its broad transmission band (visible through MWIR), low emissivity, and high hardness. Future applications will require not only the best optical quality but also higher strength and cost-effective fabrication of large panels. CeraNova's objective for this program is to demonstrate and improve capability for making large transparent spinel windows with high optical quality and high strength.

Specifications Required: The goal is to produce windows with equibiaxial strength greater than 300MPa and a Weibull modulus greater than 6 measured on samples sectioned from a window that is greater than 16" (406mm) on edge.

Technology Developed: CeraNova spinel has 2-3 times the mechanical strength of current, commercially available spinel and has a greater MWIR transmission range than aluminum oxynitride (ALON). CeraNova achieved the specified strength objective on disks samples (see photo) which had strength of 400 MPa and Weibull modulus of 7.3. Initial scale up was a plate 6.6 inches (167mm) on edge and 0.46 inches (11.8 mm) thickness. CeraNova's wet processing method has also been developed to produce larger shapes with complex curvature.

Warfighter Value: Transparent spinel has many potential advantages for multiple platforms. Aircraft window applications are considered both mission critical and safety critical. Spinel has high strength and hardness which significantly increases survivability. Lifecycle costs for spinel are much lower than for ZnS (Cleartran). In addition, spinel offers a large weight savings vs. ZnS. Spinel has a lower specific gravity than ZnS (3.57 g/cc vs. 4.08 g/cc) and the improved mechanical strength for spinel enables thinner windows to support the required load. For an equivalent window area, a spinel window is expected to weigh approximately 40% less than a ZnS window.

WHEN

Contract Number: N68335-16-C-0131 **Ending on:** January 4, 2018

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Produce window blank 16x16x0.8 inch (406x406x20 mm)	Med	Demonstrate scale-up: crack-free blank; high optical quality	3	February 2017
Mechanical & optical testing of coupons cut from polished window	Med	Meet or exceed required mechanical & optical specifications	4	August 2017
Produce 24x24x0.8 inch (610x610x20 mm) blank	High	Demonstrate scale-up: crack-free blank; high optical quality	4	August 2017
Produce inspection polished 24x24x0.8 inch (610x610x20 mm) window	High	Demonstrate capability to polish large spinel window	4	January 2018

HOW

Projected Business Model: CeraNova envisions two commercialization strategies for transparent spinel: 1) as producer, and 2) as technology licensor. CeraNova plans to manufacture transparent ceramic components for sale to Prime and second tier DoD contractors and to commercial markets. CeraNova with contract with or license the process to an appropriate vendor for manufacturing, if the quantities required exceed our production capacity.

Company Objectives: CeraNova Corporation specializes in process and product development of innovative, high technology ceramic materials for DoD and commercial markets. We provide our customers with the highest quality products, engineering expertise, service, and robust technical solutions that implement the latest ceramic technology advances. CeraNova develops transparent optical ceramics for demanding defense applications such as sensor windows, missile domes and transparent armor. We actively seek application partners and commercialization opportunities for transitioning our technology developments to prototype and pilot-scale manufacturing.

Potential Commercial Applications: Commercial applications for transparent spinel include transparent vehicular armor and protective screens for personal electronics. CeraNova's ceramic processing expertise for high strength transparent ceramics also has been successfully applied to non-optical ceramic products.

Contact: Marina R. Pascucci, Ph.D., Director, Government Programs & Contracts
mpascucci@ceranova.com 508-460-0300