Embedded Multifunctional Optical Sensor System, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

Physical Optics Corporation (POC) proposes to continue the development of a novel Embedded Multifunctional Optical Sensor (EMOS) System. The EMOS addresses NASA's need for in situ sensor systems for use on rigid and/or flexible ablative thermal protection system (TPS) materials to measure multiple TPS structural, aerothermal, and aerodynamic response parameters including temperature, heat flux, and pressure. EMOS is based on use of novel materials for high-temperature operation and uniquely designed fiber optic microsensors. The EMOS system is capable of simultaneously measuring multiple TPS response parameters (e.g., pressure, temperature, and heat flux) using a suite of miniature (diameter <400 micron) fiber optic sensors. An EMOS will tolerate operating temperatures >1500 degrees C and measurement errors within 0.4% for temperature sensors, 0.2% for pressure sensors, and 20% for heat flux measurement. The outcome of the Phase I EMOS program was the successful feasibility demonstration of the proposed EMOS technology, capable of operating at temperatures at >1500 degrees C. At the end of Phase II, POC will perform a technology readiness level (TRL)-6 demonstration of the EMOS at POC or at NASA facilities, and will deliver to NASA a fully operational EMOS system prototype.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: The proposed EMOS system will provide for NASA a distributed and embedded in situ system for measurement of TPS response in aerothermal and aerodynamic environments. It will provide better traceability from the modeling and design tools to actual performance, because the resultant EMOS data can lead to higher-fidelity design tools, improved risk quantification, decreased heat shield mass, and increases in direct payload. For specific NASA applications, these microsensors can be applied to different types of ablative

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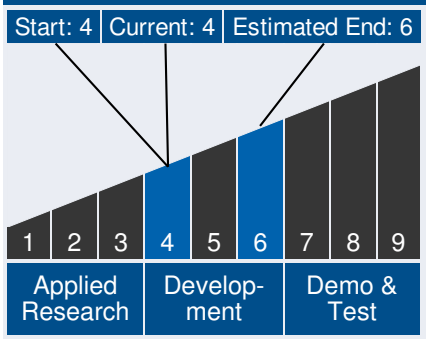
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

Continued on following page.

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materials used for TPSs including, but not limited to, PICA, PICA-X, SIRCA, Superlight Ablator (SLA), and Avcoat, and those under development for planetary aerocapture and entry as well as return to Earth.

To the commercial space industry:

Potential Non-NASA Commercial Applications: Military applications of the EMOS system will include health monitoring of military aircraft components. The military will benefit from this technology by incorporating EMOS into the engine and drivetrain components of rotorcraft to monitor, in situ and in real time, potential component failure, to reduce the amount of inspection and testing required, and increase reliability and mission availability. Commercial applications include health monitoring of industrial control and heavy equipment used in construction and mining operations, commercial aircraft engines, drivetrain systems, and utility systems. An immediate application of the EMOS system will be monitoring coal-fired power plants, natural-gas-based power plants, geothermal plants, as well as other power-generation facilities throughout the nation. This sensor suite can be used directly in critical high-temperature power plant components including superheater and reheater pendants for in-situ real-time condition monitoring.

Management Team *(cont.)*

Principal Investigator:

- Naibing Ma

Technology Areas

Primary Technology Area:
Entry, Descent, and Landing Systems (TA 9)
└ Aeroassist and Atmospheric Entry (TA 9.1)
  └ Instrumentation and Health Monitoring (TA 9.1.5)

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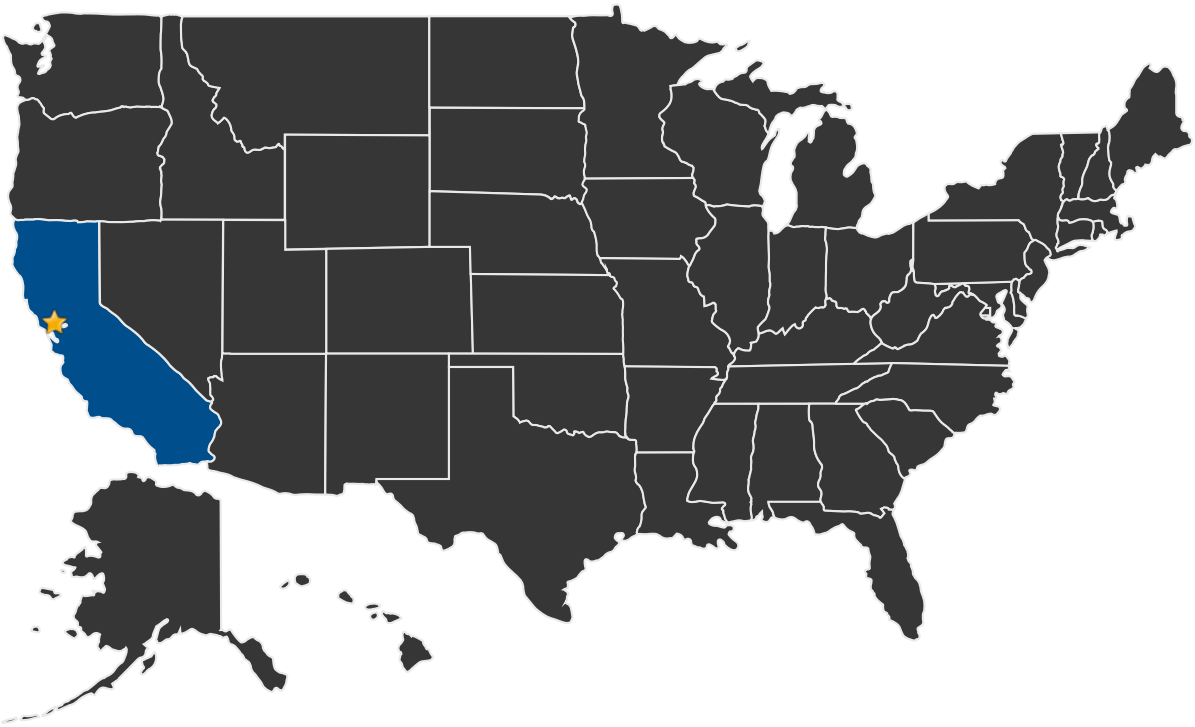
U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Ames Research Center

Other Organizations Performing Work:

- Physical Optics Corporation (Torrance, CA)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23136)

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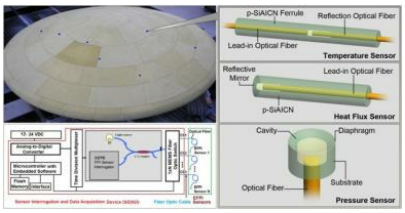
IMAGE GALLERY



Embedded Multifunctional Optical Sensor System, Phase II

DETAILS FOR TECHNOLOGY 1

Technology Title

Embedded Multifunctional Optical Sensor System, Phase II

Potential Applications

The proposed EMOS system will provide for NASA a distributed and embedded in situ system for measurement of TPS response in aerothermal and aerodynamic environments. It will provide better traceability from the modeling and design tools to actual performance, because the resultant EMOS data can lead to higher-fidelity design tools, improved risk quantification, decreased heat shield mass, and increases in direct payload. For specific NASA applications, these microsensors can be applied to different types of ablative materials used for TPSs including, but not limited to, PICA, PICA-X, SIRCA, Superlight Ablator (SLA), and Avcoat, and those under development for planetary aerocapture and entry as well as return to Earth.