Detectors with Improved Near-to-Mid IR Performance and Reduced Cooling Requirements, Phase II Project

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

ABSTRACT

This program will develop an ultra-high performance infrared detector manufacturing technology with improved performance and cost effectiveness, and reduced cooling requirements when compared to the best commercially available HgCdTe and InGaAs detectors. This will be accomplished using a two-pronged approach addressing both device design and materials. First, the conventional pn photodiode device is replaced with a new device structure, the nBn detector, which inherently suppresses performance-limiting dark currents, such as those produced by surface leakage. Second, highly manufacturable III-V materials are used, which are further enhanced with Amethyst's proprietary UV hydrogenation defect mitigation process. The result is a low cost, high performance detectors operating in the 2 – 5 micron wavelength region. There is a pressing need for ultra-high sensitivity detectors operating in this region for the detection of trace gases and chemicals. In Phase I Amethyst produced a 2.8 micron cutoff detector. The program met all objectives, demonstrating considerable improvements in performance over conventional pn diodes using the nBn and hydrogenation approach. In Phase II, Amethyst will design, fabricate and test high performance detectors individually optimized with cutoff wavelengths throughout 2–5 micron wavelength range. These detectors will have improved detectivity, and significantly reduced cooling requirements compared to currently available commercial detectors. In addition, Amethyst will deliver a thermoelectrically cooled 3.3 micron wavelength cutoff detector to JPL's Microdevices Laboratory for comparative testing and to assist in development of methane detector systems. The overall objective of the Phase II is to establish performance metrics, manufacturing process, characterize and life test single element devices. These efforts will help establish a US based manufacturing source of these ultra-high performance detectors.

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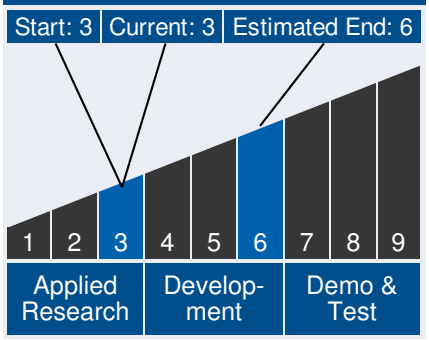
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

Continued on following page.

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ANTICIPATED BENEFITS

To NASA funded missions:

For planetary sciences there is a pressing need for more sensitive infrared detectors that operate in the 2 – 5 micron wavelength band. These detectors can be used with cavity enhanced laser and Raman spectrometers for trace gas detection and chemical analysis. Currently NASA is having to purchase detectors from foreign sources. This program will establish a US source of high performance detectors. In addition, the detectors operate at temperatures that can be reached using only thermo-electric coolers, greatly expanding the platform types, and portability of where these detectors can be utilized. Examples of NASA programs that could take advantage of this detector technology include PICASSO and MatISSE.

To the commercial space industry:

The high performance IR detector can be used in a variety of high sensitivity gas sensors and spectroscopic applications, and hence addresses multiple markets. The detector's selectivity, sensitivity and rapid response time make this an ideal detector for instruments sensing a wide variety of trace gases, for land-based, space based, and airborne measurements. Examples of trace gas sensing applications include vapors from solvents used in manufacturing, emissions from the burning of fossil fuels, and the release of chemical weapons. The important areas of public application include homeland security, detection of chemical and biological weapons, industrial process control, and medical diagnostics through breath testing. Another potential market for this technology is environmental pollution monitoring of methane and carbon dioxide.

Management Team *(cont.)*

Project Manager:

- Robert Jones

Principal Investigator:

- Terry Golding

Technology Areas

Primary Technology Area:
Science Instruments, Observatories, and Sensor Systems (TA 8)
└ Remote Sensing Instruments and Sensors (TA 8.1)
└ Detectors and Focal Planes (TA 8.1.1)
└ Large Format Visible/Near Infrared Photon Counting Detector Array (TA 8.1.1.6)

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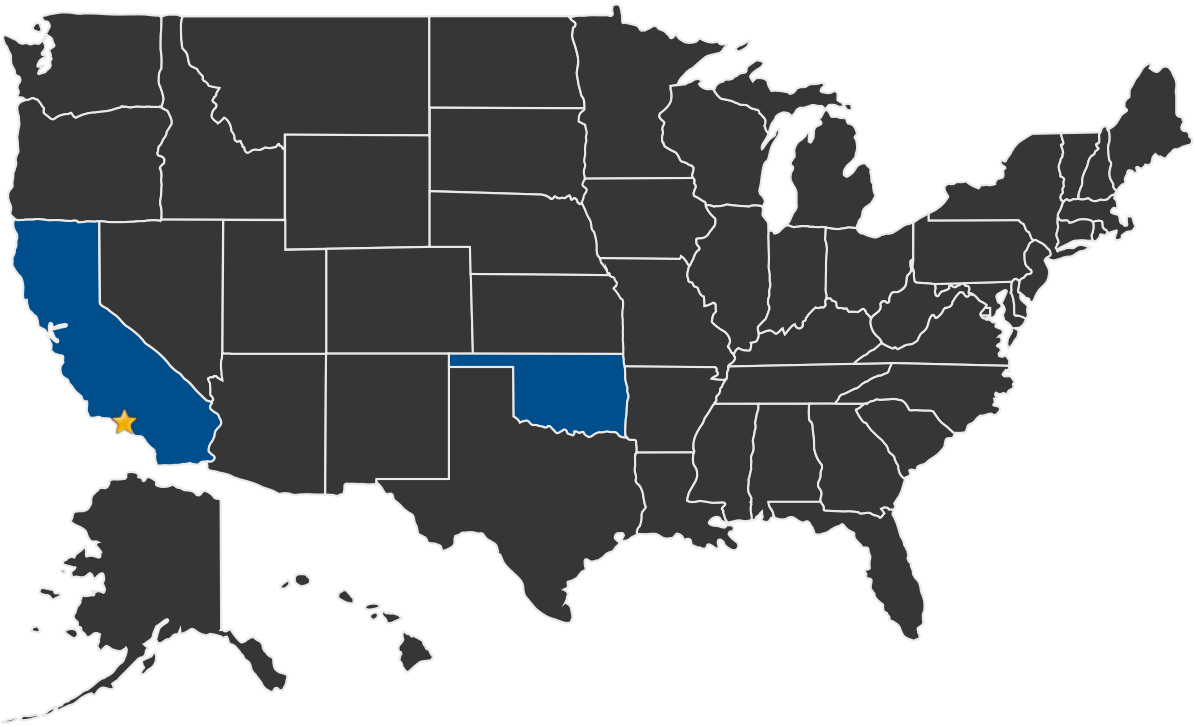
U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Jet Propulsion Laboratory

Other Organizations Performing Work:

- Amethyst Research Inc. (Ardmore, OK)
- University of Oklahoma (Norman, OK)

IMAGE GALLERY

Detectors with Improved Near-to-Mid IR Performance and Reduced Cooling Requirements

DETAILS FOR TECHNOLOGY 1

Technology Title

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