NASA SBIR/STTR Technologies

S1.01-9291 - Modified High Gain APDs for Multi-beam Ladar Instrumentation

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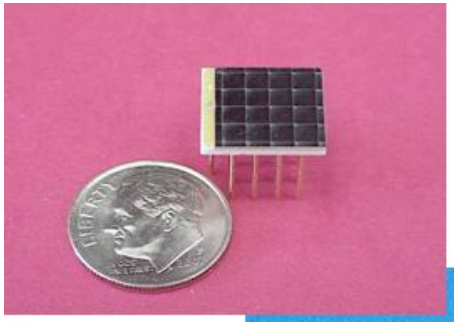

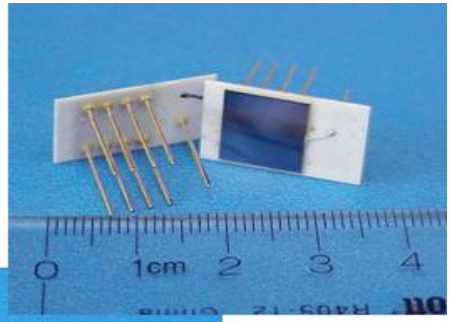

Identification and Significance of Innovation

The use of multiple wavelengths from solid-state Nd:YAG lasers (1064 nm, 532 nm, and 355 nm) has enabled great advances in satellite, airborne and ground Light Detection and Ranging (Lidar) systems for aerosol and cloud analysis. However, the development of matching receiver technology has lagged behind. While silicon and vacuum tube detectors provide adequate sensitivity across the visible, their relatively weak response to the near-infrared and ultraviolet (UV) limits system performance.

To address this need, RMD's scientists have been actively exploring methods to modify our silicon avalanche photodiode (APD) detector technology and achieve improved response at select wavelengths. As a result, we have demonstrated the highest reports response at 1064 nm with internal gains approaching 1000. Under this grant, we will explore a method to enhance the UV sensitivity of our APD detectors using a recently realized processing procedure.

Estimated TRL at beginning and end of contract: (Begin: 2 End: 5)

Technical Objectives and Work Plan

1. Realize APD efficiencies of > 70% and bandwidths of ~ 200 MHz at 355 nm
2. Maintain high gain (> 1000) and low noise (< 20 fW/Hz) APD performance
3. Demonstrate an amplified optical receiver with gains of > 1 million at > 100 MHz.
4. Meet required receiver specifications for use in UV or multi-wavelength Lidar for atmospheric studies.

Work Plan:
1. Design and fabricate APDs with modified surface layers,
2. Characterize fabricated APD detectors and compare with state-of-the-art,
3. Design, assemble and test a high bandwidth receiver,
4. Evaluate Phase II multi-wavelength design, and
5. Provide reports and documentation.

NASA Applications

Satellite, airborne and ground Lidar platforms for aerosol and cloud analysis missions, including:
Aerosol-Cloud-Ecosystem (ACE)
Doppler Wind Lidar for Surface Topology (LIST)
Geostationary Coastal and Air Pollution Events (GEO-CAPE)
Cloud physics Lidar (CPL)
Raman Lidar

Non-NASA Applications

Commercial systems for LAser Detection And Ranging (ladar) during daylight operation
Non-line of sight optical communications
Fluorescence lifetime analysis and imaging
Tracking applications for vehicle and object movement
Scintillation detection for radiation monitoring for health and homeland security interests

Firm Contacts

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NON-PROPRIETARY DATA