NASA SBIR/STTR Technologies

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

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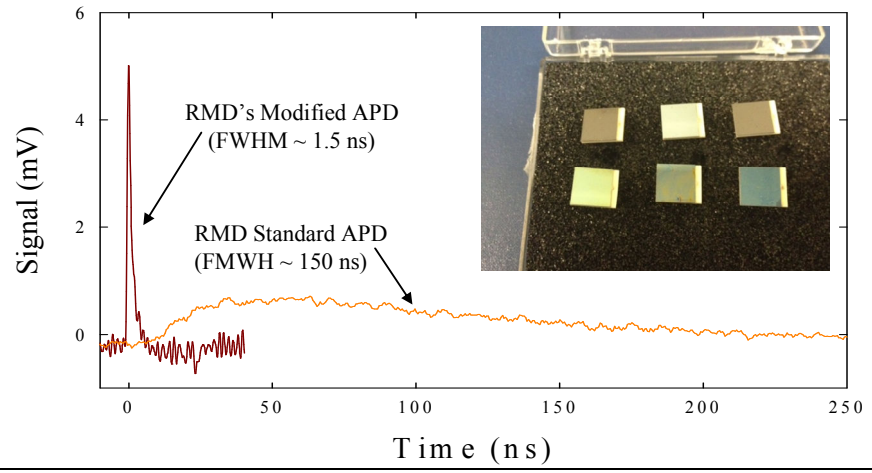
Identification and Significance of Innovation

The use of multiple wavelengths from solid-state lasers 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 explored a method to enhance the UV sensitivity of our APD detectors using a recently realized processing procedure.

Expected TRL Range at the end of Contract: (5 - 6)

Temporal response of RMD's 1 cm² APDs to a sub-ns blue laser pulse



Technical Objectives and Work Plan

Phase I Program Accomplishment

1. Fabricated working 1 cm2 APDs with a range of surface doping concentrations.
2. Achieved bandwidths of > 250 MHz, 10x faster than our standard detector.
3. Fabricated devices with > 70% internal quantum efficiency in the UV and > 90% in the near-IR
4. Maintain high gain and low noise APD characteristics of RMD's standard APDs
5. Demonstrate an amplified optical receiver with gains of > 1 million at > 80 MHz.

Phase II Technical Goals

1. Fabricate APD detectors that achieve > 30 mA/W and > 250 MHz from 300 to 1064 nm.
2. Use AR coatings to obtain QEs >70% at 355 and 532 nm and >60% at 1064 nm.
3. Detect signals as weak as 0.1 pW from short pulsed (< 10 ns) laser sources.
4. Build, demonstrate and deliver to NASA a prototype multi-wavelength Lidar receiver.

NASA and Non-NASA Applications

- Satellite, airborne and ground Lidar platforms for aerosol and cloud analysis
- ACE, LIST, GEO-CAPE, CPL Missions
- Raman Lidar
- Commercial systems for Lidar during daylight operation
- Non-line of sight optical communications
- Fluorescence lifetime analysis and imaging
- Tracking applications for vehicle and object movement
- X-ray detection for radiation monitoring for health and homeland security interests

Firm Contacts

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