NASA SBIR/STTR Technologies

Extended wavelength InP based avalanche diodes for MWIR response

Princeton Lightwave, Inc.

Cranbury, NJ

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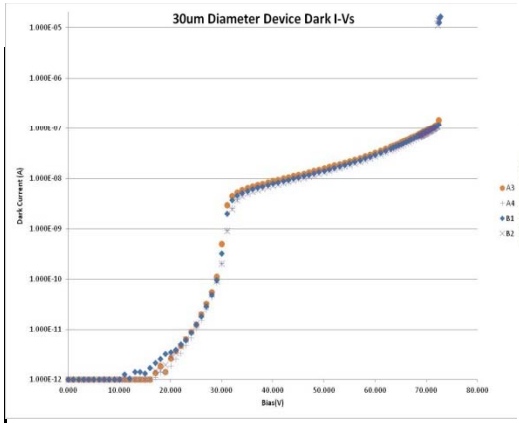
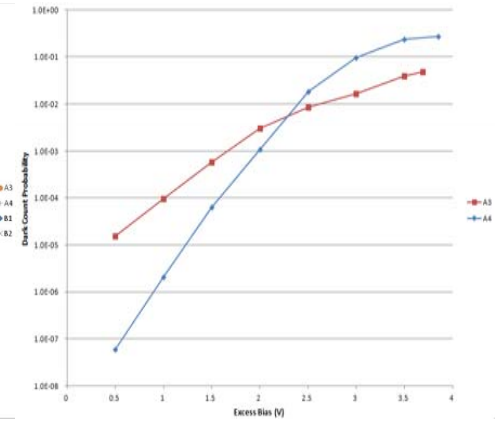
Identification and Significance of Innovation

For this Phase I NASA STTR program, we have carried out design work, modeling, device fabrication and device characterization to demonstrate the feasibility of broad-band single photon counting detectors and arrays suitable for deployment in spacecraft for in-situ compositional analysis and mapping. We have also devised novel quantum well device design concepts that can extend our detection wavelength beyond 5µm. This enables a detector with broad spectral response with reduced cooling requirements, offering a reliable detector technology with small size weight and power requirements that is ideal for future planetary missions. Concept feasibility was demonstrated.





Results for 2.4 µm cutoff; dark current (left), dark count rate (right) shows device feasibility for single photon counting detectors with Type II QWs

Technical Objectives Phase II

- Demonstration of a single photon counting APD for broad band detection from 0.9 to 4 µm wavelengths
- Photon detection efficiency of at least 20%
- Operation at temperatures accessible using thermoelectric cooling (200 K or higher)
- compatibility with well-established bulk InP multiplication regions, planar passivation and dopant-diffused junctions for quick prototyping and commercialization after Phase II program

Work Plan:

- Development of a robust wafer growth process using Metalorganic Chemical Vapor Deposition (MOCVD) reactor.
- Fabrication of InP based superlattice APDs in linear array format, packaged and characterized.
- Delivery of prototype units and final report to NASA

NASA Applications (future planetary missions & Mars rover 2018)

High sensitivity in-situ compositional analyses, deep space – Earth long distance optical communication links, 3-D planetary terrain mapping, and robot arm compatible time-gated detectors (and arrays).

Non-NASA Applications:

Industrial sensing, spectroscopy, security (border and airborne patrol), defense (laser radar for target identification and detection, night vision, infrared thermal sensors, and remote sensing), and biomedical (molecular spectroscopy).

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