NASA SBIR/STTR Technologies

S1.09-9261 - Next generation gamma/neutron detectors for planetary science.

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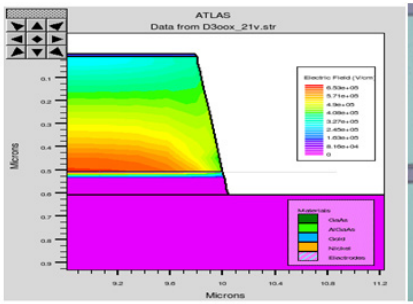
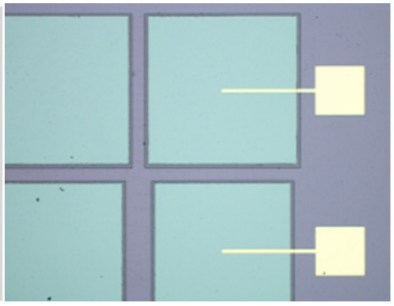
Identification and Significance of Innovation

Gamma ray and neutron spectroscopy are well established techniques for determining the chemical composition of planetary surfaces, atmospheres, and small cosmic bodies such as asteroids and comets. We are developing next generation gamma-ray and neutron detectors based on wide-band-gap solid-state photomultipliers (SSPM) coupled to emerging scintillation materials for gamma and neutron spectroscopic studies of planetary bodies. The wide band-gap SSPM is based on AlGaAs, which exhibits much lower dark noise, improved radiation hardness, and with aluminum concentration tailored to optically match the emission spectrum of emerging scintillation materials such as CLYC and $CeBr_3$. The advantages of AlGaAs SSPM and the excellent properties of CLYC and CeBr3 scintillators make them a perfect match in the development of next generation gamma neutron spectrometers for studies of small cosmic bodies and other NASA planetary science projects and missions.

Expected TRL Range at the end of Contract (1):



Phase-1 demonstrated the feasibility of AlGaAs GPD designs with both mesa and planar guard-ring structures



Phase-1 demonstrated a recipe for fabricating AlGaAs devices and fabricated AlGaAs test diodes using preliminary recipe

Technical Objectives and Work Plan

The technical objectives of the phase-I program are to:

- Provide evaluation results on the space radiation environment.
- Optimize SSPM structures to provide lower dark noise.
- Optimize quantum efficiency from 300 nm to 500 nm.
- Design SSPM for relevant scintillation materials that are ideal for planetary science.

The work plan contans the following tasks:

Task 1.Simulation in radiation environment
Task 2. Design AlGaAs Geiger Photodiode structures.
Task 3. Simulation of AlGaAs Geiger Photodiode characteristics.
Task 4. Design prototype GPD and develop fabrication process.
Task 5. Characterize and analyze CLYC, and CeBr3 scintillators.
Task 6. Write Reports and Phase-II Proposal.

NASA and Non-NASA Applications

The nominal NASA application will be for a gamma-ray and neutron spectrometer. The complete spectrometer can be used for Earth science missions, planetary missions, exploration of small cosmic bodies such as asteroids and comets, satellite radio-imaging, and space exploration probes.

The new detector can be used for non-NASA applications in homeland security, science experiments, dosimeters for radiation therapy, and detectors in medical applications such as PET and SPECT.

Firm Contacts

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NON-PROPRIETARY DATA