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RADIATION EFFECTS ON HIGH RESOLUTION DIGITAL INSB IMAGING DETECTOR

Abstract

Infrared (IR) detectors are useful in many fields including security, military, industrial, scientific, medical and space applications. The space industry uses IR detectors for several applications. Among these are weather monitoring, astronomical exploration, spacecraft utilities, and more. One of the common materials for IR imaging detectors is the III-V compound semiconductor InSb, which shows the best performance in terms of high quantum efficiency and array uniformity up to its cut-off wavelength of 5.4μm. As for any other electronic device operated in a space environment, the IR detector must endure irradiation from various sources. The published work about radiation effects on InSb imaging detectors is sparse. Here we present a campaign of three irradiation tests performed on an InSb imaging detector. The goal of this campaign is to explore the effects of radiation on detector performance. This work is focused on the Focal Plane Array (FPA) of the IR detector, which contains the p-n InSb photo-diode array, as well as the CMOS based Read Out Integrated Circuit (ROIC). Both of these components are custom devices. Other standard electronic components required for the detector's operation are not included in the test. SCD's 'Hercules', a digital 1280x1024 pixels detector with 15μm pitch, is a natural selection for studying radiation effects on high performance MWIR imaging detector for space applications. The test campaign included 3 experiments: 1. Gamma induced Total Ionizing Dose (TID) – considering effects on both the InSb p-n diodes as well as the CMOS ROIC. 2. Proton induced Displacement Damage (DD) – considering effects mostly on the InSb p-n diodes and to some extent on the CMOS ROIC. 3. Heavy ions Single Event Latchup (SEL) – considering effects only on the CMOS ROIC. The InSb infrared detector is operated at cryogenic temperature (normally about 77K) in order to reduce the dark current to below the photo-current. Since some radiation effects, as well as relaxation processes following the radiation damage, are temperature dependent, all the tests described above on the FPA were performed at cryogenic temperatures. In this paper we present the main results of these experiments on the 'Hercules' FPA.