IN-SITU CRYOGENIC SEE TESTING OF HIGH-SPEED SiGe BiCMOS DEVICES
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ABSTRACT

Previous work has demonstrated that single event effects are dependent on temperature [1]. Here, we present details of a first-of-a-kind system that has been custom-designed to enable in-situ single-event (SE) testing at cryogenic temperatures. The system is capable of using either liquid nitrogen (LN\textsubscript{2}, 77K) or liquid helium (LHe, 4K) as cryogens, and also includes a heating plate for fine adjustment of temperatures. This enables emulation of combined temperature and radiation environments such as those on the surfaces of the Earth’s moon and those of other planets like Jupiter (Europa) and Saturn (Enceladus), where surface temperatures fluctuate from 50K at night to 400K during daytime.

Fig. 1 shows a sketch of the customized cryogenic system (Dewar). It is designed to be portable in terms of size, and weighs under 20 lbs. The Dewar has been made “flange adaptable” so that it can be ported and fitted to the beamline flange at a given facility through a “taper flange”. Another key feature of the Dewar is a rotation stage that can rotate the device under test (DUT) in situ around the vertical axis, as shown in Fig. 1. This saves beam time that otherwise would have been spent in stopping the beam and releasing the vacuum to manually rotate the DUT. The Dewar can be hooked up to a temperature controller that can be used for heating up the DUT in situ to study potential latchup effects. For measurements, there are provisions for both RF-type and low-speed connectors. Good thermal conductivity between the Dewar cold-plate and the DUT is ensured by an in-house fabricated “cold-finger”. Details of in-house Dewar qualification and other features will be provided in the final presentation.

While research has been carried out on characterizing the SE response of high-speed SiGe BiCMOS devices at room temperature (RT) [2-5], no recent work has been reported on the cryo SE response of the same due to heavy ions to the best of our knowledge. As part of the NASA Exploration Technology Development Program (ETDP), this project aims to fill that void and aid future NASA missions to the above planets and/or moons by providing both qualitative and quantitative insights into the SE response of high-speed SiGe BiCMOS devices at cryogenic temperatures. This work also establishes excellent synergy with other NASA efforts such as the Radiation Hardened Electronics for Space Environments (RHESE) and NASA Electronic Parts and Packaging (NEPP) programs.

REFERENCES


