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ASSESSING THE EFFECTS OF RADIATION ON GAN SEMICONDUCTORS FOR COTS SPACE APPLICATIONS

Abstract

Electronics are a critical component of all space technology and can be affected by the extreme environmental conditions that they endure while remaining in space. The effects of radiation can inhibit or prevent microelectronics from successful operation in space. This can affect accurate data collection and assessment from highly computational devices, as well as intersatellite communication, and communication with spacecraft and Earth based technology. This research will explore improvements in the durability of microelectronics in space, by assessing the current states of technology and radiation effects on current semiconductor devices and new materials that can be adapted for space applications in microelectronics. One new material of interest for space electronics is Gallium Nitride. Gallium Nitride (GaN) as a material for semiconductors in space applications will be assessed for its ability to perform and increase the microelectronics lifespan in radiation environments such as Total Ionizing Dose (TID) and Single Event Effects (SEE). GaN is a highly efficient, compact and durable semiconductor material that is able to operate successfully at a smaller size and weight than a silicon semiconductor. While silicon semiconductors have pre-existing testing for defining their ability to perform in different radiation environments, GaN does not have defined standards. By assessing its behavior in varying radiation conditions, these standards can be constructed and used for space-bound electronics. If implemented into standard COTS designs, this would allow for improved resilient satellites that are less costly and easier for space implementation. As a result, smaller space ventures would be able to have reliable satellites in orbit, at reasonable costs and at faster rates. In addition to satellite applications, GaN semiconductors could be implemented into ISS electronics and future spacecraft designs. Further research in this area of semiconductor technology will be necessary for improving the longevity and cost-effective nature of COTS for small satellites, commercial, and military applications as well as for further long duration space exploration.