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DEVELOP AN ULTRA-LOW POWER MEMRISTOR-BASED DETECTOR FOR RADIATION SENSING AND DOSIMETRY ON BOARD SATELLITES

Abstract

Radiation is a highly disruptive characteristic of space environment. Therefore, important considerations have to be taken into account in order to prevent the severe effects caused by the interaction of ionizing particles with the different electronic systems of the satellite. One of the unique RD projects that is strongly aligned with the UAE Space Agency's Science, Technology, and Innovation objectives is being conducted by Khalifa University in the UAE. The main objective of this project is to investigate the use of memristors for ultra-low power radiation detection to monitor the long-term electronic health of satellites. A memristor-based detector would form an ideal basis for satellite dosimetry given their low power requirements (in the microwatt range), low weight, compact size and integrated all-electronic readout features. These together allow circumventing a number of challenges in coupling a detector to a satellite probe such as the large costs associated with the payload weight and the need for high power efficiency. Memristor-based radiation detectors promise to significantly improve the present state-of-the-art of onboard and remote satellite dosimetry. In this paper, synthesis of optimized memristor device and its electronic characterization, in addition to the design of the electronic readout circuit system are presented. Device testing under space-like conditions (vacuum and extreme temperature) is viewed accompanied by initial experiments of device optimization for radiation testing. This is followed by an overview of the simulations and calculations that are developed as part of the validation and verification (VV) process to support prediction of the device response to various relevant radiation exposures; including both laboratory radiation and space radiation conditions. Consistent with its strategic objectives, the UAESA's enabling role in advancing space science and technology by funding University RD provides a perfect environment for examining such issues, with an added benefit of nurturing human capital development of the next generation.