IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures I - Development and Verification (Space Vehicles and Components) (1)

Author: Dr. Bhaskar Mukherjee
The University of Sydney, Australia

Mr. Uday Bhonsle
United Arab Emirates
Mr. Tanveer Ahmed
Digantara Research and Technologies Private Limited, India
Dr. Clemens Woda
Helmholtz-Muenchen, Germany
Dr. Vladimir Mares
Helmholtz-Muenchen, Germany

RADIATION HARDNESS TESTING OF CUBESAT SOLAR PANELS USING THE PARASITIC FAST NEUTRONS PRODUCED AT PETTRACE 800 MEDICAL CYCLOTRON

Abstract

Outer space is flooded with ionizing radiations composed of: (a) Galactic Cosmic Radiation (GCR) 87% high-energy protons, 12% helium nuclei and an assortment of heavy charged (HZE) particles, (b) Trapped radiation field in the Van Allen belt (VAB) surrounding our earth made of energetic (1keV-250MeV) protons and low energy (up to 10 MeV) electrons, (c) Solar flares or solar particle events (SPE) originated in solar corona made of 95% protons, 4% helium nuclei, ¡1% electron and ¡1% HZE particles. Ionizing radiations inflict detrimental effects in electronics. Hence, all vital electronic components relevant to orbiting spacecrafts exposed to above space radiations are prone to radiation induced performance degradation. During routine production of the widely used PET radio-pharmaceutical (18FDG) enriched water target (H218O) is bombarded with a proton beam (10 – 15 MeV) from Medical Cyclotron, thereby generating a copious number of energetic stray neutrons. The authors have developed a novel technique for radiation hardness testing of spacecraft electronics utilizing these stray neutrons. The Cube Sat solar panels are the most vulnerable entity (no shielding) exposed to harsh space radiations. We have emulated a typical Cube Sat solar panel by a cluster of small (5.4 mm x 4.3 mm x 3.2 mm) Silicon PIN Photodiode (BPW34). The PIN diode clusters were attached to PET radioisotope (18F) production target of the PET-trace 800 Medical Cyclotron operated by the Gulf International Cancer Centre, Al Bahia, UAE. The diode-clusters were exposed during radioisotope production regimen at various activity yield (GBq) levels. The proton beam was monitored in real time whereas the energy distribution of the stray neutrons estimated by Monte Carlo (MCNPX 2.6) simulations. We have estimated the radiation-induced degradation by illuminating the photo-diodes with simulated sunlight, and simultaneously measuring the open circuit voltage (mV). The feasibility of a novel radiation hardness-ground-testing rig for microelectronic components for potential space applications using hospital based radioisotope production Medical Cyclotrons is highlighted in our report.