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PERFORMANCE AND DEGRADATION ANALYSIS OF POLYCRYSTALLINE PHOTOVOLTAIC PANELS IN NEAR-SPACE ENVIRONMENTS

Abstract

Understanding the performance and durability of photovoltaic panels under extreme conditions is critical for advancing space exploration technologies. This study examined the effects of near-space environments on the performance and degradation of polycrystalline photovoltaic (PV) panels. The research aimed to assess the panels' behaviour and explore their potential use in high-energy particle detection systems.

The experiment was conducted aboard the BEXUS 35 stratospheric balloon. Polycrystalline PV panels were mounted on a flight module and shielded from direct sunlight to focus on their performance under ionising radiation and space-like conditions. The panels' dark voltage and current were continuously measured and recorded during the flight using Geiger-Mueller sensors. Atmospheric data, including temperature and pressure, were also collected as part of the experiment's housekeeping systems. Control panels remained on Earth to enable comparative analysis.

Post-flight testing and data analysis provided insights into the mechanisms of panel degradation and their potential to serve as radiation detectors. Collected data about dark voltage and current of the panels were correlated with background radiation levels derived from the GOES satellites. This study contributed to understanding the challenges associated with using photovoltaic panels in extreme environments, such as the dark sides of celestial bodies or deep space missions where exposure to ionising radiation is significant.

This research advanced the field of energy systems for space applications by providing critical data on the performance of photovoltaic panels under near-space conditions. It also highlighted the potential for

dual-use applications, including particle detection, offering valuable insights for scientists and engineers developing next-generation PV technologies for aerospace missions.