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THERMAL RESILIENCE TEST METHOD AND STRATEGY FOR SOLAR CELLS SPACE QUALIFICATION

Abstract

Satellites and spacecrafts face a true challenge when it comes to sustainable and reliable power sources. Different advanced solar cell technologies have been developed to exploit solar power from the Sun; however, these solar cells must withstand extreme environmental conditions and it becomes essential to achieve a Space Qualification, through a rigorous testing process. This procedure can be complex and costly, requiring collaboration with Space Companies for the tests. To try to solve this problem, at Kyushu Institute of Technology we are experimenting with a new test-setup and test-strategy to try to qualify a new type of solar cell for space usage, within our facilities. This study focused on the thermal aspect of the Space Qualification, through the High Temperature Long Exposition (HTLE) test conducted in thermal vacuum chamber and the Thermal Equilibrium test in controlled thermal chamber. These experiments are significant for assessing the solar cells' resilience to major thermal conditions, with respect to the JAXA standards. The HTLE test involved subjecting the solar cells to elevated temperatures, replicating the intense heat encountered during prolonged exposure to the Sun in space. This phase of the experiment sought to evaluate the solar cells' performance and stability under conditions that mimic the maximum thermal stress anticipated in orbit. In tandem, the Thermal Equilibrium test focused on assessing the solar cells' adaptability to thermal fluctuations, transitioning between oppressive cold and hot temperatures. The ability to maintain structural efficiency during extreme thermal variation is crucial for sustained functionality during the satellite's orbital journey. The two experiments placed emphasis on the drastic environment that the solar cells need to endure, with both scorching heat when facing the Sun and frigid cold when in the shadow of the Earth. The outcomes of the HTLE and Thermal Equilibrium tests want to provide valuable insights into these test-methods, to try to propose a way to meet the criteria for space usage and, at the same time, simplify and reduce the costs of these expensive procedures.