IAF SPACE POWER SYMPOSIUM (C3)
Advanced Space Power Technologies (3)

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SIX YEARS OF SPACEFLIGHT RESULTS FROM THE ALSAT-1N THIN-FILM SOLAR CELL (TFSC) EXPERIMENT

Abstract

The increasing power demands of spacecraft payloads and the realistic prospect of space based solar power (SBSP) stations as a means of providing zero carbon electricity in the 2030s, means that there is an emerging requirement for large area, yet lightweight, solar photovoltaic (PV) arrays that will provide far greater power (kWpeak) than is currently available. To be practical, such arrays will need to use solar cells which have a much higher specific power (i.e. power per unit mass) and a much lower cost per watt than current space-rated solar PV technologies. To this end, the Centre for Solar Energy Research (CSER) at Swansea University have been working on a new solar cell technology, based on thin film cadmium telluride (CdTe), deposited directly onto ultra-thin space qualified cover glass material. This offers a potentially high specific power, low-cost technology, which is sufficiently flexible to allow "roll-out" deployment strategies. Four prototype cells were flown as part of the Thin-Film Solar Cell (TFSC) experimental payload, developed by CSER and the Surrey Space Centre (SSC), on the joint Algerian Space Agency (ASAL) – UK Space Agency AlSAT-1N Technology Demonstration CubeSat, launched into a 661 km x 700 km, 98.20 deg. Sun Synchronous orbit, on 26th September 2016. The experiment has provided the first in-orbit current/voltage (I/V) measurements of this novel technology, and more than five years of flight results have now yielded new insights into its longer term performance and inherent radiation hardness, which makes them particularly attractive for maintaining high end-of-life (EOL) performance for long duration space missions. The results help to strengthen the argument for further development this technology for space application. The data, collected over nearly 30,000 orbits, show no signs of cell delamination (a potential risk for such technologies), no deterioration in short circuit current or in series resistance. However, all four cell's fill factors were observed to decrease over the duration of the mission, caused primarily by a decrease in their shunt resistance. This has been attributed to the diffusion of gold atoms from the back electrical contacts. We conclude therefore that further development of this technology should utilise more stable back contacting methodologies more commonly employed for terrestrial CdTe modules. However, this flight has proven the basic soundness of the technology for use in space.