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EXPERIMENTAL PERFORMANCE EVALUATION OF THE PHOTOVOLTAIC-BARE-TETHER PROPULSION CONCEPT UNDER SPACE CONDITIONS FOR DEORBIT APPLICATIONS

Abstract

Due to their simplicity, electrodynamic tethers are promising when it comes to deorbiting satellites at their end of life, thus preventing future space debris. Despite progress being made, the power requirement for a propellant-less and thus compact cathode remains a challenge. This is especially true, if the tether-system shall be completely independent of the satellite that may not be functional any more. Preserving tether simplicity, a novel approach is the development of a photovoltaic tether, which combines bare tether electron collector technology with a tether segment being coated with thin film CIGS solar cells, thus autonomously providing electrical power for propellant-less thermionic or field emission emitters. As CIGS thin film solar cells are still poorly examined under space conditions, this paper will provide data of their electrical performance under space conditions, uncover operational challenges and propose appropriate solutions and workarounds. Our degradation analysis was done using an LED based solar simulator inside our vacuum chamber, an UV-radiation source as well as exposure of PV samples to atomic oxygen. In addition to this, the phenomenon of solar cell shading and hot spot formation was investigated. The latter constituting a condition for potentially fatal system failure, which for example may be caused through deposition of outgassing materials or improper assembly. The outcome of our analysis provides crucial input to the PV-Bare-Tether propulsion concept and will complement ongoing analysis of the concept with realistic data.