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TEST CAMPAIGN TO DETERMINE THE PROPERTIES AND SPACE DURABILITY OF AN ELECTRODYNAMIC LOW WORK FUNCTION TETHER

Abstract

Space debris is a growing problem and threat to future space missions. The number of objects in an earths orbit increases exponentially as the costs of placing a satellite there continue to decline. This makes it easier for companies and research institutions to launch small satellites or experimental satellites into orbit. Deorbiting of these objects after a failure or end of life is fundamental to ensure the safety of ongoing and future space missions. The H2020 E.T.Pack project is developing a deorbit kit based on an electrodynamic low work function tether (LWT) coated with electride material. Due to an electrodynamic effect, one end of the LWT captures electrons from the ambient plasma while the opposite end emits electrons due to the thermionic and photoelectric effects. While moving through the Earth's magnetic field, the electric current through the tether generates a Lorentz force that drags the spacecraft towards earth. In order to determine the properties and suitability for space operation of the LWT and to ensure its functionality, a test campaign for a number of samples was conducted. The samples have to undergo various tests and measurements executed by Technische Universität Dresden (TUD), Fraunhofer IKTS and German Aerospace Center (DLR) to examine the mechanical, electrical and optical properties, as well as degradation behavior due to the space environment. The measurements to determine the material properties include: tensile tests, work function measurements, photocurrent density measurements, electron density measurements and emissivity and absorptivity measurements. To examine space durability, the material undergoes an atomic oxygen exposure test, an UV radiation exposure test and a thermal cycling test. The influence of these tests on the material properties is examined afterwards. This publication will provide an overview of the test plan and test procedures. The results of the individual tests and measurements are presented and discussed.