Paper ID: 9026
student

SPACE DEBRIS SYMPOSIUM (A6)
Hypervelocity Impacts and Protection (3)

Author: Mr. Atsushi Yanagida
Waseda University, Japan, kaiseikaiseikaisei@gmail.com

Ms. Satomi Kawamoto
Japan Aerospace Exploration Agency (JAXA), Japan, kawamoto.satomi@jaxa.jp
Dr. Masumi Higashide
Japan Aerospace Exploration Agency (JAXA), Japan, higaside@chofu.jaxa.jp
Dr. Sunao Hasegawa
Japan Aerospace Exploration Agency (JAXA), ISAS, Japan, hasehase@isas.jaxa.jp
Prof. Susumu Toda
Waseda University, Japan, stoda@parkcity.ne.jp

STUDY OF HYPERVELOCITY IMPACT ON ELECTRODYNAMIC TETHER FOR TETHER LIFETIME EVALUATION

Abstract

Hypervelocity impact experiments on electrodynamic tethers

The electrodynamic tether (EDT) is one of the most promising propulsion systems for de-orbiting debris in low earth orbit (LEO). End-of-mission de-orbit required by debris mitigation guidelines and orbital transfer for active debris removal require much propellant if a conventional propulsion system is used. An EDT, on the other hand, can provide deceleration without the need for propellant or high electrical power. However, a tether is very long and thin structure, and it can be easily severed by small debris impacts. So the expected lifetime of the tether needs to be evaluated for mission analysis. In order to calculate the expected lifetime, two parameters are used: DTC (critical distance of tether) and dc (The fatal debris diameter). In the past, some hypervelocity impact experiments were conducted on non-conductive tethers and these two parameters for non-conductive tether had been reported while no data for a conductive tether is reported. Thus hypervelocity impact experiments on electrodynamic tether were conducted using a large-sized two-stage light gas gun at ISAS in JAXA. Projectile is made by Aluminum or SUS, and its diameter is 0.1[mm] 0.3[mm]. Tether consists of twisted SUS and Aluminum wires. As a result of hypervelocity experiments, dc and DTC were calculated and it was shown that the conductive tether used in the experiments has good tolerance to small sized debris impact compared with non-conductive tethers.