21st IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Interactive Presentations - 21st IAA SYMPOSIUM ON SPACE DEBRIS (IP)

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PLASMA MEANS OF COMBATING TECHNOGENIC DEBRIS IN SPACE

Abstract

One of the negative result of satellites operation on orbit is the formation of space debris, in particular, space dust. Collision of a satellite with fine-dispersed technogenic particles leads to accelerated degradation of coatings and reduction of their functionality, which ultimately affects the reduction of service life of low-orbit spacecraft. Degradation is an order of magnitude faster if the surface of the spacecraft is under potential with respect to surrounding plasma. In this case, each collision of the particle with the surface leads to a microarc discharge on the surface, in the zone of which a larger part of the SC surface is involved than it would be in the case of a simple collision. A large number of satellites are equipped with plasma sources, mainly electric propulsion (EP). The EP's jet propagates into space for several kilometers, forming artificial plasma formations (APF). While plasma relaxation mechanisms absence, the plasma keeps its parameters practically unchanged throughout the entire APF volume. The report proposes a method of combating dust fine particles of the order of microns to hundreds of microns in size with the help of artificial plasma formations. The principle of the effect of plasma formations on space debris is based on the fact that in a plasma with high-energy electrons the body is charged to a large negative potential and is bombarded by ions accelerated in the plasma sheath. This results in surface atomization, melting, and even vaporization. The nature of electromagnetic and force interaction between plasma and a body moving in is determined by the ratio of the Debye radius rD of the charge shielding to the body size, a. For the real parameters of the APF, space debris particles less than 1 cm in size are in this sense small bodies, and the condition r> a is satisfied, for example, for aluminum particles up to 10 g in mass. The report describes the mechanisms of heating, melting and subsequent disintegration of the droplet under the action of electrostatic stretching forces. For realization of these processes the APF should be hot enough (U>10...100V). The process of deceleration of the body in a low-temperature APF is practically interesting, if there is such a decrease in velocity, which provides a decrease in the perigee of the debris orbit to a height of H 200km, which leads to capture of a debris by atmosphere.