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Author: Mr. Rohan M Ganapathy
Hindusthan College of Engineering and Technology, India, rohan2692@yahoo.in

Mr. Pradeep Raja P
Karpagam College of Engineering, India, ajar.pradeep@gmail.com
Mr. Sakthi Guhan
India, sakthiiguhan@gmail.com

STUDY AND ANALYSIS OF PLUME BACKFLOW FROM A LITHIUM MAGNETOPLASMADYNAMIC THRUSTER ENABLED ON AN EXPERIMENTAL NANO-SATELLITE

Abstract

The primary goal of this study is to estimate the spacecraft contamination potential due to plume back flow from a lithium magneto-plasma-dynamic thruster during operation phase. An approximate assessment is first made of the maximum allowable rate of lithium deposition onto radiators associated with the assumed nuclear power plant of a typical host spacecraft. Contamination assessment then involves modeling the plume from the thruster using a hybrid particle-fluid approach to determine the lithium flux behind the thruster. It is anticipated that backflow can be significantly reduced through deployment of a plume shield that is included in the plume simulations. The plume results indicate a strong sensitivity to the fraction of mass emitted by the thruster in the form of cold, slow atoms created by ions recombining on the anode. Contamination is assessed for an example spacecraft geometry. It is found that some backflux occurs even in the absence of charge exchange collisions. It is also found that the spacecraft can be protected from backflow contamination by appropriate sizing of the plume shield