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Author: Mr. Kailashnath Bharathan
SASTRA University, India

Mr. Anirudh Balaji N S
SASTRA University, India

COMPUTATIONAL ANALYSIS AND PERFORMANCE EVALUATION OF ILIS THRUSTER WITH EXPERIMENTAL RESULTS

Abstract

The early 20th century was the beginning of electrospray electric propulsion and the invention of colloidal thrusters. Gradually there is a great rise in the usage of nanosatellite systems. Nanosatellites are being used widely for academic research, space exploration, earth observation, and remote sensing. Electrospray electric propulsion systems involving Ionic Liquid Ion Sources(ILIS) provide potential drag-free control and efficient performance under disturbance compensation systems. ILIS utilizes molten salts (ionic liquids) to produce a mixture of ion droplets. The requirement of the neutralizer is negated due to the presence of molten salts. The ionic liquid surface is stressed by an electric field to aid the extraction of ions for high-velocity acceleration. An array of ILIS tips consisting of a sharp tip with an ionic liquid coating is placed with the vicinity of a metal extraction plate. The inefficiency of this system arises due to the non-uniform beam composition, analysis of the liquid properties and its effect on performance will enable a highly efficient system. ILIS systems have the advantage of being able to produce negative ions with similar masses to their positive counterparts having similar current levels. It opens up the possibility of achieving plume electrical neutrality without electron emitters. In this paper, we aim to provide a performance analysis of Ionic Liquid Ion Sources (ILIS) by computational means and validate the same using experimental results. Also, the Taylor cone formation is being computationally analyzed. In addition, the Taylor cone droplet dynamics has certain aspects which can be analyzed like the thrust output, the specific impulse, maximum power output in watts, and the current output. These factors are analyzed at the tip of the emitter surface.