Hybrid-PIC Simulation of Hall ThrusterPlume on an Unstructured Grid with DSMC Collisions

CELIK MURAT - SANTI Mark - MARTINEZ-SANCHEZ Manuel - PERAIRE Jamie

MASSACHUSETTS INSTITUTE OF TECHNOLOGY - UNITED STATES OF AMERICA

Although several operational codes are available for the prediction of plume dynamics of Hall thrusters and their interactions with spacecraft surfaces, their coverage of the range of physical phenomena involved and their ability to model complex geometries and material combinations has tended to be fairly restricted. We have initiated the development of a more comprehensive suite of models intended to be used either on their own, or as modules in an overall architecture of the type recently initiated at the Air Force Research Laboratory (Fife, et al.). As a first stage in this development, the simplified physics currently embodied in the existing plume code (D. Oh, 1997) is being implemented in a new unstructured tetrahedral grid designed to couple with the surface grids generated by the AFRL for realistic representation of a typical spacecraft. Also, more recent refinements on sputtering and material deposition and a method for predicting plasma behavior in non-quasineutral regions will be incorporated. The code will model Xenon ions, double ions and neutrals kinetically, whereas the electrons will be modeled as a fluid continuum. Direct Simulation Monte Carlo (DSMC) techniques will be used to simulate the important collisions between kinetically modeled particles.

Results will be presented to illustrate the potential of the new grid for assessing details of the plume effects on various parts of the spacecraft. Further developments will include more refined plasma and surface models.