Abstract Submitted
for the GEC16 Meeting of
The American Physical Society

A Coupled MHD and Thermal Model Including Electrostatic Sheath for Magnetoplasmadynamic Thruster Simulation[1] AKIRA KAWASAKI, KENICHI KUBOTA, IKKOH FUNAKI, Japan Aerospace Exploration Agency, YOSHIHIRO OKUNO, Tokyo Institute of Technology — Steady-state and self-field magnetoplasmadynamic (MPD) thruster, which utilizes high-intensity direct-current (DC) discharge, is one of the prospective candidates of future high-power electric propulsion devices. In order to accurately assess the thrust performance and the electrode temperature, input electric power and wall heat flux must correctly be evaluated where electrostatic sheaths formed in close proximity of the electrodes affect these quantities. Conventional model simulates only plasma flows occurring in MPD thrusters with the absence of electrostatic sheath consideration. Therefore, this study extends the conventional model to a coupled magnetohydrodynamic (MHD) and thermal model by incorporating the phenomena relevant to the electrostatic sheaths. The sheaths are implemented as boundary condition of the MHD model on the walls. This model simulated the operation of the 100-kW-class thruster at discharge current ranging from 6 to 10 kA with argon propellant. The extended model reproduced the discharge voltages and wall heat load which are consistent with past experimental results. In addition, the simulation results indicated that cathode sheath voltages account for approximately 57 V subject to approximately 20 V of discharge voltages applied between the electrodes.

[1]This work was supported by JSPS KAKENHI Grant Numbers 26289328 and 15J10821.

Akira Kawasaki
Japan Aerospace Exploration Agency

Date submitted: 09 Jun 2016 Electronic form version 1.4