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STUDY ON DISCHARGE CHARACTERISTICS AND MODE TRANSITION PHENOMENON IN A HELICON PLASMA THRUSTER

Abstract

A global energy and particle balance model is developed to study discharge phenomenon in a Helicon Plasma Thruster (HPT). The model mainly incorporates particle losses and volume generation mechanisms, e.g. ion wall sheath loss, volume ionization and combination, ambi-polar flow loss in tube downstream, neutral depletion and electron energy balance mechanisms in a open end discharge tube, which is modified from the traditional closed tube model to simulate the practice conditions in a HPT. Nagoya III type antenna is used to excite the Helicon and TG waves where the plasma source tube is 2.5cm, vacuum chamber is 1.2m in diameter and 2m in length, Electron power absorption is calculated from the sum of Helicon-TG wave energies. The balance equations are integrated as time functions until stable solutions are obtained which give ion and neutral particle density, electron temperature. Radiofrequency(rf) of 67.8MHz, neutral gas flow rates range from 10sccm-100sccm, rf power range from 50W-300W are studied to compare the simulation results with the experiments conducted previously and verify the validity of the modified model. The model is then used to study the mode transition phenomenon reported by many paper, especially those observes in a Helicon Double Layer Thruster(HDLT) and explore possible mechanisms of density jump phenomenon. fi