Thrust measurements of a Charge-exchange Thruster

Adam Israel*, Joe Khachan
School of Physics, University of Sydney, Australia
Israel@physics.usyd.edu.au

A new type of electric propulsion system is presented whereby an asymmetric hollow cathode glow discharge is created within the thruster and ions are accelerated toward the exit nozzle. A novel characteristic of this thruster is the neutralization of the ions via charge-exchange reactions with the background gas, which is the dominant ion-neutral reaction at operating voltages of the order of ten- kV and currents of mA. The thruster is entirely self-contained with ions created, accelerated and neutralized within cathode. Langmuir probe measurements have shown the existence of a sharp potential 'ramp' within the cathode with a maximum potential drop of approximately 90% of the applied cathode voltage, resulting in highly energetic and collimated beams of neutral atomic hydrogen ejected from the cathode. Doppler-shift spectroscopy was used to measure the speed of the exiting neutral atoms which gave a specific impulse and thrust to be of the order of 10^4 s and 100 μN respectively for hydrogen gas. These estimates were then correlated with Monte Carlo simulations and direct thrust measurements employing a torsion-pendulum. It was found that there is agreement with the thrust estimates and direct measurement to within an order of magnitude accuracy.