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ELECTRON CURRENTS IN HALL THRUSTER

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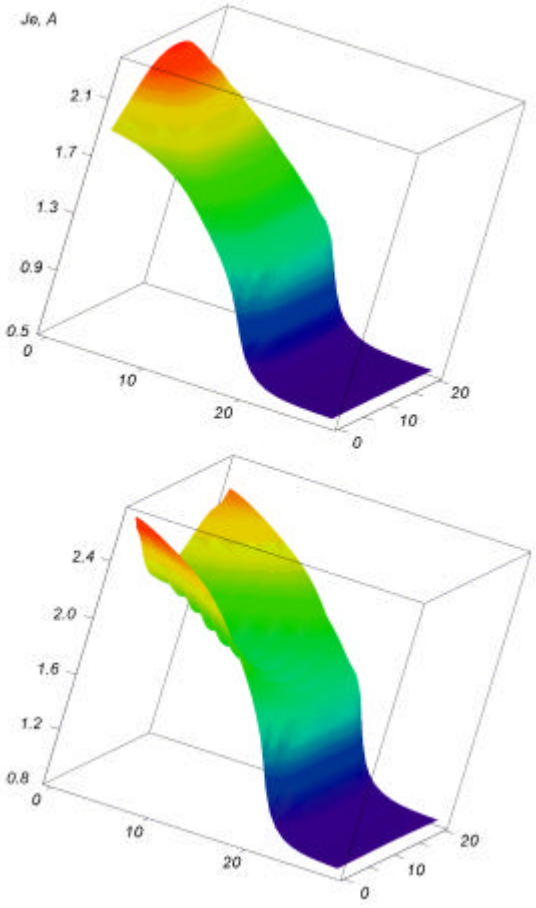
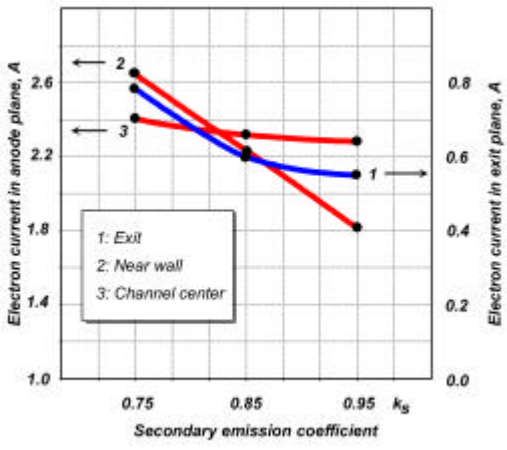
The electron current is one of the main characteristics of a Hall thruster. Electron current to the anode determines plasma density in thruster channel, efficiency of ionization and hence the thruster efficiency. In the framework of the model developed (ref. abstract "Kinetic model of the electron and ion transport in hall thrusters" in the present Proceedings), the electron currents in thruster channel were studied for various secondary emission coefficients (k_{see} = 0.95 for upper 3D figure and k_{see} = 0.75 for 3D lower figure).





The figures show that the influence of secondary emission is stronger near the anode plane. With the secondary emission coefficient increased (k_{see} = 0.95, upper 3D figure), the near-wall plasma is cooled by the secondary electrons, this causes decrease in the electron mobility and current to the anode. For smaller emission coefficient (k_{see} = 0.75, lower 3D figure), the cooling is small but collisions of energetic electrons with dielectric channel walls provide increase in near-wall conductivity and total electron current to the anode. In the other hand, the decreased wall potential in the anode plane area stipulates essential current non-uniformity across the channel width.

At the exit plane the secondary electrons cannot influence the total electron current significantly because they are strongly magnetized in the intense magnetic field present in this area. The increased wall potential provides quick repelling of the low-energetic secondary electrons along the magnetic field line; this equalizes the current distribution across the channel width as shown in the lower 3D image. As a result, the electron current profile remains uniform at any values of the emission coefficient reasonable for boron nitride walls.

The graph illustrates the electron currents in the thruster anode and exit planes as a function of emission coefficient. One can see that the electron current behavior changes when the emission coefficient increases from 0.75 to 0.95. The near-wall current for smaller emission coefficient exceeds the current in channel center. For emission coefficient equal to 0.82 approx., electron near-wall current is equal to current in channel center. With higher coefficients, the electron near-wall current is less than current in channel center.

The 'convex' current profile typical for small emission coefficient becomes 'flat' when the coefficient equals to 0.82 approx. The current profile becomes 'concave' for higher coefficient as shown in the lower 3D image.