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Abstract for an Invited Paper
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Kinetic effects in Hall thruster discharge

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The purpose of the talk is to describe recent advances in nonlocal electron kinetics in low-pressure plasmas. The talk will briefly review the invited papers of "Nonlocal, Collisionless Electron Transport in Plasmas" workshop, which are published in the special issue of IEEE Transactions on Plasma Science **34**, N3 (2006). As an example of importance of taking into account kinetic effects, the Hall thruster will be discussed. Recent analytical studies and particle-in-cell simulations suggested that the electron velocity distribution function in a Hall thruster plasma is non-Maxwellian and anisotropic. The electron average kinetic energy in the direction parallel to walls is several times larger than the electron average kinetic energy in direction normal to the walls. Electrons are stratified into several groups depending on their origin (e.g., plasma discharge or thruster channel walls) and confinement (e.g., lost on the walls or trapped in the plasma). Practical analytical formulas are derived for wall fluxes, secondary electron fluxes, plasma parameters and conductivity. The calculations based on analytical formulas agree well with the results of numerical simulations. The self-consistent analysis demonstrates that elastic electron scattering on collisions with atoms and ions plays a key role in formation of the electron velocity distribution function and plasma-wall interaction. The fluxes of electrons from the plasma bulk are shown to be proportional to the rate of scattering to loss cone, thus collision frequency determines the wall potential and secondary electron fluxes. Secondary electron emission from the walls is shown to enhance the electron conductivity across the magnetic field, while having almost no effect on insulating properties of the near-wall sheaths. Such a self-consistent decoupling between secondary electron emission effects on electron energy losses and electron crossed-field transport is currently not captured by the existing fluid and hybrid models of the Hall thrusters.