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Electronegative Plasma Discharge Equilibria

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The equilibrium of electronegative discharges is studied in the plane-parallel approximation over a wide range of pressure and electron densities, encompassing a number of regimes that have previously been modeled analytically. The transitions between the various regimes (models) have been determined in the input parameter space. It is shown that for a given feedstock gas, these transitions can be found in terms of the two input parameters plp and ne0lp, where p is the pressure, ne0 the electron density, and lp the system half-length. Here ne0 is used as a convenient input related to the power, and the conversion from electron power to ne0 is given. The input parameter space is partitioned by whether ion flux to the wall or positive-negative ion recombination is the dominant positive ion loss mechanism. For each of the principal regimes, scaling laws are developed for the most important plasma parameters in terms of the input parameters. Extensions to 2D discharges and to plasmas with axial magnetic fields are briefly considered.