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Electronegative Plasma Equilibria with Spatially-Varying Ionization[1] M.A. LIEBERMAN, E. KAWAMURA, A.J. LICHTENBERG, UC Berkeley — Electronegative inductive discharges in higher pressure ranges typically exhibit localized ionization near the coil structure, with decay of the ionization into the central discharge. We use a two-dimensional fluid code [1] with chlorine feedstock to determine the spatial profiles of the plasma parameters in a cylindrical transformer-coupled plasma device excited by a planar coil. To compare with one-dimensional (1D) analytic modeling, the results are area-averaged. The ionization is found to decay roughly exponentially along the axial direction, allowing the ansatz of an exponentially decaying ionization to be used in a 1D computational model. The model captures the main features of the axial variations of the area-averaged fluid simulation, indicating that the main diffusion mechanisms act along the axial direction. A simple analytic global discharge model is developed, accounting for the asymmetric density and ionization profiles. The global model gives the scalings with power and pressure of volume-averaged densities, electron temperature, and ionization decay rate, also in reasonable agreement with the scalings obtained by averaging the simulation results.

[1] E. Kawamura, D.B. Graves, and M.A. Lieberman, Plasma Sources Sci. Technol. 20, 035009 (2012)

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