Abstract Submitted
for the GEC13 Meeting of
The American Physical Society

An Analytical Model for the Radio-Frequency Sheath UWE CZARNETZKI, Ruhr-University Bochum, Faculty for Physics and Astronomy — An analytical model for the planar radio frequency (RF) sheath in capacitive discharges is developed based on the applied RF voltage as the boundary condition. In a first step, the individual sheath voltages and the self-bias are calculated using a cubic-charge voltage relation. In the second step, a single integro-differential equation is derived to describe the ion flow velocity in the sheath under all conditions of collisionality. Central to the model is the screening function that describes the screening of the ion density by the mean electron density in the sheath. Numerical integration of the sheath equation is straight forward. However, for the collisionless as well as the collisional case explicit, simple, and precise analytical approximations can be found. Drift velocities, densities, fields, currents, and charge-voltage relations are calculated. Further, the Child-Langmuir laws for both cases of collisonality are derived. These solutions are in very good agreement with experimental data from the literature based on laser electric field measurements, the Brinkmann sheath model, and PIC simulations. The technique works well also for other waveforms, e.g. the electrical asymmetry effect or tailored pulse waveforms.

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Date submitted: 14 Jun 2013 Electronic form version 1.4