Abstract of the Dissertation

The Plasma Boundary Sheath as a Nonlinear Element

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Capacitive coupled radio frequency plasma discharges (RF-CCPs) play a major role in material processing; they are used for several of plasma processes such as sputtering, deposing, and etching, which are essential for a large industrial market. Analyzing RF-CCPs dynamics is complicated even using simple approaches. Therefore, the purpose of this thesis is to establish a simple but sufficiently accurate global model of the RF modulated plasma boundary sheath. In particular, the effective charge voltage characteristics formula that controls RF-CCPs nonlinear dynamics has been obtained numerically for collisional and collisionless regimes by analyzing self-consistent numerical solutions of fluid model. In addition, the new general formula of sheath voltage distribution has been derived from the algebraic sheath model. The sheath voltage of arbitrary waveforms was investigated in capacitive discharges after the RF effect had been applied. The accuracy of the formula of $V(Q)$ distribution was verified against experimental results, in conjunction with model PIC simulations. This assesses the quality of the global model.