GEC09-2009-000323

Abstract for an Invited Paper
for the GEC09 Meeting of
the American Physical Society

Multi-frequency, finite-wavelength and dc-augmentation effects in large area capacitive sources[1]

MARK KUSHNER, University of Michigan

The scaling of high frequency, multi-frequency capacitively coupled plasmas (CCPs) to large areas has many challenges. It has been well established that electromagnetic (EM) effects become increasingly more important as the frequency of excitation increases while the diameter of the substrate also increases. The complexity of the system increases with the addition of dc-augmentation. Although much as been learned about EM effects, scaling laws are difficult to develop because the discharge characteristics are functions of the frequency dependence of the conductivity, the response of the electron energy distribution (EED) to the electric fields that penetrate into the plasma, the geometry of the reactor, gas mixture, pressure and dc augmentation power. In the case of multi-frequency excitation, the coupling of low and high frequencies through surface waves and through the bulk plasma is also an issue. In this talk we will discuss results from a computational investigation of multi- and high- frequency (up to 200 MHz) excitation of CCPs having diameters up to 450 mm, with and without dc augmentation. The model used in this study includes a full time-domain solution of Maxwell's equations that enables investigation of coupling between frequencies. A Monte Carlo simulation is used to predict EEDs as a function of position and ion energy distributions to the substrate. Gas mixtures (e.g., Ar and Ar/CF_4), pressures (10 mTorr to 100 mTorr) and geometry (gap size) are investigated. Methods to minimize EM effects will be discussed by using variable conductivity and shaped electrodes; and segmented electrodes in which the electrical path from the generator to any point in the plasma is made as consistent as possible.

[1]Work supported by Semiconductor Research Corp., Tokyo Electron, Applied Materials and Department of Energy.