Motivation

Dual-frequency drives have been used to independently control ion density and ion energy distribution function (IEDF). It is natural to extend this idea using three frequency drives. In this idea, the high frequency controls the ion density and the two low frequencies control the spread and the mean of the ion energy distribution.

This simulation uses a tri-frequency drive system at 64, 8, and 2 MHz in an attempt to understand the behavior of the three frequencies. The frequencies are chosen such that the faster cycles are periodic with each slower cycle. The 64 MHz is kept at 400 V.

2005 Main Objectives

Model coordination and experimental comparison (M20, VIL5)

Determine energy depositions and ion energy distributions in dual frequency capacitive discharges using kinetic simulations. Couple these results to model for reacting neutral flow and plasma properties for dielectric etch chemistry with comparison to experiment.

Simulation Configuration

Input Parameters

Number of Cells = 500 => max Δx/2Δ = 0.8
Superparticle Weighting = 1 * 10^10
Time Step = 7.629394 * 10^-2 s => max v_max * Δt = 0.08
Length = 0.05 m
Area = 0.5 m²
Pressure = 4 Pa (0.03 torr)
Gas = Ar
Electrons Collisional
Ions Non-Collisional
Initial Density of Particles = 1 * 10^16

IEDF (V_{64} = 400 V, V_{8} + V_{2} = 800 V)

Future Goals

Models for novel tool control (M35)

Perform particle-in-cell simulations with dual and/or triple frequency source power to determine ion energy distributions at substrate. Perform fluid simulations to determine effects on neutral species concentration. Couple reactor scale simulations with profile scale simulations, including coupling with atomistic simulations.

Acknowledgement