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Electrical Asymmetry Effect in Very High Frequency Capacitively Coupled Plasmas XIAOPU LI, KALLOL BERA, SHAHID RAUF, Applied Materials Inc — Capacitively coupled plasmas (CCP) are widely used in the semiconductor industry for plasma-enhanced chemical vapor deposition (PECVD), atomic layer deposition (PEALD) and plasma etching applications. Spatial uniformity of critical discharge characteristics such as species densities and ion energy distribution is important for achieving optimum processing results. However, the spatial distribution of CCP discharge can be significantly affected by electromagnetic effect (EME) at very high frequency (VHF). Stringent processing conditions also require flexible control of ion fluxes and energies for adequate selectivity. Electrical asymmetric effect (EAE) has been extensively studied for separate control of ion flux and energy by applying a fundamental frequency and its higher harmonics in CCP discharges. In this study, EAE is systematically investigated by tailored-waveform excitations in the VHF regime where EME becomes significant. A fully coupled electromagnetic fluid plasma model is used to simultaneously study both EAE and EME. Argon CCP discharge is excited using VHF source in a geometrically asymmetric reactor. The discharge asymmetry is electrically tuned by tailored waveforms. This study provides fundamental understandings of the interplay between EAE and EME and insights to flexible control of ion fluxes and energies in the VHF CCP discharge.

Xiaopu Li
Applied Materials Inc

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