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Electrical Asymmetric Effect in Very High Frequency Capacitively Coupled Plasma Source using Electromagnetic Plasma Model XIAOPU LI, KALLOL BERA, SHAHID RAUF, KEN COLLINS, Applied Materials Inc — Capacitively coupled plasmas (CCP) are widely used for semiconductor material processing. One of the challenges for advanced material processing using CCP discharges is the flexibility of tuning species fluxes and energies. Recently, electrical asymmetric effect (EAE) has been studied [1, 2], where separate control of ion flux and ion energy is achieved by applying a fundamental frequency and its higher harmonics. In the present study, EAE is investigated by tailored-waveform excitations in the very high frequency (VHF) regime where electromagnetic effect becomes significant. A fully coupled electromagnetic plasma model is used to evaluate EAE in a CCP discharge. The fluid plasma model computes species densities and fluxes, as well as the plasma current density. The electromagnetic phenomena are described by the Maxwell equations with the plasma current density updated from the fluid model. The finite difference time domain (FDTD) technique is used to discretize the Maxwell equations. A geometrically asymmetric Ar discharge is excited using the VHF source and its harmonics. The phase between the excitation frequency and its harmonics has been modulated to control the electrical asymmetry for different spacing and pressures. This study provides a fundamental understanding of EAE that is important to achieve flexible control of ion fluxes and energies in VHF CCP discharges. 1. U Czarnetzki et al, J. Phys.: Conf. Ser. 162 012010 (2009) 2. T Lafleur, 2016 Plasma Sources Sci. Technol. 25 013001 (2016)

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