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Particle-in-cell simulation of multi-frequency capacitively-coupled plasmas at low pressure: a 2D perspective PENG TIAN, JUN-CHIEH WANG, JASON KENNEY, SHAHID RAUF, Applied Materials, JULIAN SCHULZE, IHOR KOROLOV, Ruhr-University Bochum, RUHR-UNIVERSITY BOCHUM COLLABORATION, APPLIED MATERIALS TEAM — Multi-frequency capacitively coupled plasmas (MFCCPs) are one of the key technologies enabling forefront of current etching process in 3D NAND and FinFET manufacturing. These processes rely crucially on the precise control of plasma density profile, uniformity of ion/radical fluxes and ion energy distribution (IED) in MFCCPs. With a rapidly expanding process space due to puling of RF sources, computational modeling has become an important tool in conjunction with experimental diagnostics in understanding the intricate physical mechanisms in MFCCPs. In this paper, a 2D particle-in-cell (PIC) plasma model is used to study the kinetic behavior of low pressure (1 – 10's mTorr) MFCCPs in Ar. The low frequency RF source is at 100's kHz while 10's MHz is used for the high frequency. Simulation results show a shift of the plasma density profile from center-peak to edge-peak over pressure ranging from 2 – 20 mTorr. Simulation results are compared with experimental measurements of plasma density, fluxes and IED over a range of pressure, frequency and RF voltages.

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