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Multi-Fluid and PIC Simulation of Ion Energy Distributions through Different Aspect Ratio Holes in Capacitively Coupled Plasma[1]

YAO DU, YUHUA XIAO, STEVEN SHANNON, North Carolina State University, SANG KI NAM, Samsung Electronics Co., Ltd. — Ion energy distribution function (IEDF) plays a significant role in numerous plasma enhanced manufacturing processes in the semiconductor industry. A common objective in plasma etching is to form high aspect ratio (HAR) hole structures in a substrate. IEDF in both perpendicular and transverse directions contribute to the shape of these structures. Modelling ions travelling through HAR features helps in quantifying etching effect as a function of IEDF and optimizing etching processes. On the other hand, the IEDFs measured after different HAR features contain the information of ions velocities in both perpendicular and transverse directions at the sheath edge. Differentiation of the information with respect to different AR gives an estimate of ions angular distribution function (IADF) at the sheath edge. A low temperature plasma fluid code, Zapdos, is to be used for the global chamber simulation of a HAR process, matching the plasma conditions obtained using other diagnostic probes such as Hairpin probe and Langmuir probe and generating results to be incorporated in the input of a 2D particle-in-cell (PIC) code, XOOPIC. The PIC code is to be used for studying the evolution of the ion population through a HAR feature.

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