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Investigation on the plasma uniformity of a capacitively coupled plasma reactor using a two-dimensional GPU-based particle-in-cell simulation[1]

HAE JUNE LEE, Pusan National University

A two-dimensional particle-in-cell (PIC) simulation parallelized with graphics processing units (GPU) is a helpful design tool for the computer-aided engineering of the etching and the deposition process. Capacitively coupled plasma (CCP) reactors with the pressure range from 20 mTorr to 10 Torr are simulated for the investigation of the kinetics of electrons and ions. In the pressure range of a few Torr, the spatiotemporal profiles of electron heating and the ion energy distribution functions (IEDFs) on the substrate are sensitively affected by the change of the geometry and the boundary conditions (BCs) of the side wall. The electron Ohmic heating in the radial direction is enhanced near the side wall with a grounded conductor rather than a dielectric wall. Moreover, the change of the IEDF is more sensitive with the dual frequency driving power. In the low-pressure discharges, the effect of high-frequency driving has been investigated with an analytic model of the standing wave effect added to the electron acceleration. The comparison analysis of the local and the nonlocal kinetics is provided based on the results of the PIC simulations at different pressure.

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