Investigation of Micro-Arcing in a Capactively Coupled Plasma with a 2D Particle-In-Cell Simulation

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A Capacitively Coupled Plasma (CCP) is widely used for semiconductor manufacturing and display fabrication. One of the undefined issues for CCP chambers is the micro-arcing under a certain geometric condition in a few Torr regime. It is important to figure out the issue because an unexpected discharge may cause a damage to wafer. As a result, it gives rise to equipment downtime and yield loss. In spite of the necessity of understanding the phenomenon, few researches have been performed under real plasma conditions except for some conducted in 1D simulation. In terms of the ionization mean free path, secondary electron emission process plays an important role to initiate an anomalous micro discharge. Ion-enhanced field emission effect is considered in the simulation for determining the secondary electron emission coefficient. In micro-meter scale, the breakdown voltage drastically decreases as the gap distance between the metal patterns decreases. The phenomenon is investigated with an advanced particle-in-cell (PIC) model parallelized with a graphics processing unit (GPU). The simulation results show that the electron impact ionization of the peripheral region of the bottom electrode is highly concentrated due to micro-arcing.