Effects of Showerhead Face Chemistry on Capacitively Coupled Plasma Discharges

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Capacitively Coupled Plasma reactors frequently use showerhead electrodes to distribute feed gases. These reactors employ a perforated or porous planar surface to dispense reactant gases more-or-less uniformly over a second parallel planar surface. Simulation of these reactors is difficult because of the deposition reactions occuring on the showerhead face, and clogging up the holes. The flow emerging from the holes on the showerhead face alters the species transport to and from the surface and, therefore, affects the consumption and production of reactant gases at the surface. In addition, the biased nature of the showerhead electrode leads to secondary electron emission. At low pressures, this may not be important to the discharge, but at the typical pressures of operation (of a Torr or greater), the secondary electron emission can be the dominant plasma discharge sustaining mechanism. In this study, simulations are carried out of a CCP discharge in a GEC cell with a showerhead electrode. The effects of the showerhead face chemistry are quantified and compared with the experimental data. Different strategies for dealing the deposition reactions on the showerhead face with the porous media model are evaluated.