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Capacitively Coupled Discharge in Alpha Mode as a Plasma Varactor[1] ANDREY KHOMENKO, SERGEY MACHERET, Purdue University — Increasingly congested electromagnetic spectrum calls for RF systems to be electronically tunable and reconfigurable. Weakly ionized plasma devices can offer attractive solutions in this application because their properties depend on the electron density and frequency and can thus be electronically controlled. Since the capacitance of a plasma discharge is determined in many cases by the sheath capacitance, controlling the sheath thickness can result in a novel plasma varactor (tunable capacitor). In particular, the sheath thickness in capacitively-coupled RF discharges operating in the alpha regime is inversely proportional to the driving RF frequency. In applications, tuning the sheath thickness by carrying the driving RF frequency (e.g. 10-100 MHz) can be used to control the plasma varactor operating in a different frequency range (e.g. 300 MHz-3 GHz). The proof-of-principle experiments were conducted with parallel-plate electrode geometry in air at 1 Torr with an RF amplifier operating at a constant voltage in a wide range of frequencies, 10-120 MHz. The impedance characteristics and the sheath and plasma parameters were inferred from the current and voltage measurements supplemented with optical imaging. The experimental data confirmed that the sheath thickness is inversely proportional to the driving RF frequency, so that the capacitance is proportional to the frequency.

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