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Analytical Model for Self-Excited Plasma Series Resonances. UWE CZARNETZKI, JULIAN SCHULZE, BRIAN HEIL, DIRK LUGGENHOELSCHER, Institute for Plasma and Atomic Physics, Ruhr-University Bochum, Germany — Self-excited plasma series resonances are observed in CCP discharges as high frequency oscillations superimposed on the normal RF current. This high-frequency contribution is generated by the interaction between the capacitive sheath and the inductive (due to inertia) and ohmic bulk. The non-linearity of the sheath is essential for the whole effect. In a previous work we have described the effect in the frame of a simple one-dimensional model [1]. It could be shown that at low pressures common in etching applications, PSR can play an important role for both, the actual current waveform and the power transferred to electrons. Here the model is extended to include electron temperature and electrode area ratio effects. Both effects can lead to a reduction of the high-frequency amplitude but have no effect on the frequency itself that is within reasonable limits approximately given by $\omega_{PSR} \approx 2/3$ $(s/L)^{1/2}$ ω_{pe}, where s is the maximum sheath extension, L the characteristic length of the plasma bulk and ω_{pe} the electron plasma frequency. The derived analytical approximations agree well with numerical solutions of the model. First comparisons with experiment and a fluid-dynamic simulation including an extensive sheath model also show excellent agreement. [1] U. Czarnetzki, T. Mussenbrock, and R.P. Brinkmann, Phys. Plasmas 13, 123503 (2006)

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