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Nonlinear electron resonance heating in dual frequency capacitive discharges D. ZIEGLER, T. MUSSENBROCK, R.P. BRINKMANN, Institute for Theoretical Electrical Engineering, Ruhr University Bochum, D-44780 Bochum, Germany — Capacitively coupled plasmas (CCP's) play a major role in material processing. The drawback of conventional single frequency CCP's is that the ion bombardment energy and the ion flux to the substrate itself cannot be controlled independently. The problem can be remedied by the use of dual frequency CCP's. In such sources, the ratio of the applied frequencies is obviously an important control parameter. Rauf[1] found that at large ratios (e.g., 100 kHz/13.56 MHz) the spectrum of the discharge current was just the superposition of two single-frequency spectra. For more comparable frequencies (e.g.,6.78 MHz/13.56 MHz), however, quite surprising nonlinear effects were observed. It is exactly this nonlinear behavior and its influence on the total energy budget that is discussed in this contribution - we present and analyze a nonlinear global model for a dual frequency CCP. Based on an exact analytical solution of the underlying equations we discuss the behavior of the model for various voltage ratios, frequency ratios, and gas pressures. We investigate in particular the heating at the plasma series resonance, either by direct excitation or via the nonlinear electron resonance heating mechanism[2].

[1] S. Rauf and M.J. Kushner, IEEE Trans Plasma Sci. **27**, 1329 (1999)
[2] T. Mussenbrock and R.P. Brinkmann, Appl. Phys. Lett. **88**, 151503 (2006)

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