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On the possibility of making a geometrically symmetric RF-CCP discharge electrically asymmetric[1] UWE CZARNETZKI, BRIAN G. HEIL, Ruhr-University Bochum, Inst. for Plasma and Atomic Physics, 44780 Bochum, Germany, RALF PETER BRINKMANN, THOMAS MUSSENBROCK, Ruhr-University Bochum, Lehrstuhl f. Theoretische Elektrotechnik, 44801 Bochum, Germany — A simple solution to the demand of controlling independently ion flux and ion energy in capacitive discharges is presented. When a temporally symmetric, multi-frequency voltage wave form containing one or more even harmonics is applied to a discharge, even a geometrically symmetric one, the two sheaths are necessarily asymmetric and a DC self bias develops. Optimally, this is achieved by simultaneously applying an RF voltage composed of the phase locked fundamental and its second harmonic. The resulting DC self bias and hence the ion energy is a nearly linear function of the phase angle between the two applied RF voltages. In geometrically symmetric discharges the roles of the two electrodes can be reversed by just using the phase. The phase angle control of the ion energy leaves the applied RF voltage and frequency and thereby the plasma density, electron temperature, and ion flux effectively unchanged. An analytical model and a hybrid fluid dynamic-Monte Carlo simulation analysis are presented.

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