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Control of electron heating and ion energy distributions in capacitive plasmas by voltage waveform tailoring based on a novel power supply and impedance matching BIRK BERGER, JAMES FRANEK, STEVEN BRANDT, West Virginia University, MARTIN LIESE, MATTHIAS BARTHEL, Barthel HF, EDMUND SCHUENGEL, MARK KOEPKE, JULIAN SCHULZE, West Virginia University — We present a novel RF power supply and impedance matching to drive technological plasmas with customized voltage waveforms. By adjusting the individual phases and amplitudes of multiple consecutive harmonics any voltage waveform can be realized as a customized finite Fourier series. This RF supply system is easily adaptable to any technological plasma for industrial applications and allows the commercial utilization of process optimization based on voltage waveform tailoring for the first time. Here, this system is tested on a capacitive discharge based on three consecutive harmonics of 13.56 MHz in argon. The effect of changing the shape of the driving voltage waveform on the electron heating and sheath dynamics is investigated by Phase Resolved Optical Emission Spectroscopy (PROES) for different electrode gaps, pressures, and applied voltages. At low pressure the results are correlated with ion energy distribution functions measured at both electrodes. Tuning the phases between the applied harmonics results in an electrical control of the DC self-bias and the mean ion energy. A comparison with the reference case of a dual-frequency discharge reveals that using more than two consecutive harmonics significantly enlarges the control range of the mean ion energy.

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