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Control of ion energy distributions in capacitive RF discharges using customized voltage waveforms EDMUND SCHUENGEL, JULIAN SCHULZE, Department of Physics, West Virginia University, Morgantown, WV 26506, IHOR KOROLOV, ARANKA DERZSI, ZOLTÁN DONKÓ, Institute for Solid State Physics and Optics, Wigner Research Centre for Physics, Hungarian Academy of Sciences, Budapest, Hungary — The flux and energy distribution of ions flowing onto the substrate in capacitive radio-frequency discharges is vitally important for the plasma surface interaction. Therefore, controlling and optimizing the shape of the ion flux-energy distribution (IED) allows for an improvement of various plasma surface processing applications. Recently, separate control of the mean energy and the total flux of ions has been achieved via the Electrical Asymmetry Effect. Here, we study the control of the IED shape in capacitively coupled radio-frequency discharges by applying customized voltage waveforms to the powered electrode. Data obtained from PIC/MCC simulations in helium at low pressures show that the dominant features in the shape of the IED result from the energy gain of ions flowing into the sheath and ions created in the sheath (in ion neutral collisions) in the periodically oscillating sheath electric field. The high-energy component of the IED is determined by ions flowing into the sheath, whereas ions created within the sheath lead to peaks in the IED at lower energies. We demonstrate, how the shape of the high-energy component as well as the position (energy) and height (flux) of the peaks can be controlled by varying the phases and amplitudes of the multiple applied frequencies.

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