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Charged particle dynamics and process control in capacitive RF discharges driven by tailored voltage waveforms in mixtures of Argon and $\mathbf{CF_4}$

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The electron power absorption dynamics and the Electrical Asymmetry Effect (EAE) are computationally investigated for Argon-CF_4 gas mixtures in geometrically symmetric capacitively coupled plasmas. Simulations are performed for both single- and triple-frequency tailored voltage waveforms at 20 and 60 Pa, using a fundamental frequency of 13.56 MHz and its consecutive harmonics. The results at 60 Pa show electron power absorption mode transitions between the Drift-Ambipolar (DA) mode and the α-mode induced by varying the admixture of Ar to CF_4, which leads to a change of the plasma chemistry. In the triple-frequency cases small argon admixtures (of the order of 10 %) strongly affect the electron power absorption dynamics and the symmetry of the discharge. The change of the electrical generation of a DC self-bias via the EAE, the ion flux-energy distribution functions of different ion species at the electrodes, and the excitation of resonance effects are studied as a function of the mixing ratio of these two gases. The results are expected to be highly relevant for plasma processing, where such gas mixtures are often used.

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