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Modelling of capacitive microdischarges at atmospheric pressure

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A one-dimensional hybrid analytical-numerical global model of atmospheric pressure, radio-frequency (rf) driven capacitive discharges is developed. The feed gas is assumed to be helium with small admixtures of oxygen or nitrogen. The electrical characteristics are modeled analytically as a current-driven homogeneous discharge. The electron power balance is solved analytically to determine a time-varying Maxwellian electron temperature, which oscillates on the rf timescale. Averaging over the rf period yields effective rate coefficients for gas phase activated processes. The particle balance relations for all species are then integrated numerically to determine the equilibrium discharge parameters. The coupling of analytical solutions of the time-varying discharge and electron temperature dynamics, and numerical solutions of the discharge chemistry, allows for a fast solution of the discharge equilibrium. Variations of discharge parameters with discharge composition and rf power are determined. Comparisons are made to more accurate but numerically costly fluid models, with space and time variations, but with the range of parameters limited by computational time.