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The electron heating mode transition by the change of driving frequency in atmospheric pressure dielectric barrier discharges JUNG YEOL LEE, Department of Electrical Engineering, Pusan National University, Busan, JOHN VERBONCOEUR, Department of Electrical and Computer Engineering, Michigan State University, East Lansing, MI, HAE JUNE LEE, Department of Electrical Engineering, Pusan National University, Busan — Over the past twenty years, micro plasma technology including dielectric barrier discharges (DBDs) brought great enhancement of stable and high density plasma sources in atmospheric pressure environment. However, the experimental diagnostics are difficult to use in atmospheric pressure micro plasmas, and thus the particle-in-cell (PIC) simulation is a good tool to investigate the nonlinear and kinetic effects of the plasma dynamics. In this study, PIC simulation results show that time-dependent parameters compare well with theoretical estimates like energy diffusion theory in the RF frequency ranges up to 500 MHz in atmospheric pressure plasmas for a set of controllable input parameters. Here, alpha-gamma heating mode transition is observed when the driving frequency matches the maximum of energy relaxation frequency by electron impact excitation. The inflection point in a semi-log scaled electron energy probability function (EEPF) is also explained by energy diffusion theory, which corresponds to a transition point of heating mode. Moreover, it was found that extra results in low gas pressure have the same solution at lower input frequency. For this reason, temporal differential term generates non-stationary EEPF in a specific energy range in Boltzmann kinetics.

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