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Particle simulation of filamentary formation in dielectric barrier discharge. WEILI FAN, LIFANG DONG, College of Physics Science and Technology, Hebei University — Dielectric barrier discharge (DBD) is well known for its extensive industrial applications. Recently, new attention has been paid to DBD as a system of rich nonlinear dynamics to study the self-organized filamentary patterns. Though a number of experimental studies have been implemented, the involved physics is still not completely clear, partially due to the limitation of the available space and time-resolved diagnostics. Computer simulation has proven to be an effective tool to give insights into the discharge mechanism. So far, most simulations presented are based on fluid models. However, since the plasma is non-equilibrium in DBD where the particle velocities may deviate from the Maxwellian distribution, self-consistent kinetic simulations are required. In this paper, two successive filamentary discharges in DBD have been studied by use of two-dimensional particle-in-cell simulation with Monte Carlo collisions included (PIC-MCC). The formation of multiple filaments and the involved electric fields, electric potentials, plasma densities, and particle temperatures are presented. Results show that both of the surface charges and space charges play significant roles in the discharges. The total electric field in the gas gap has been completely reversed before the ac voltage hit zero, due to the accumulation of the surface charges, which triggers the next discharge. The space charges always exist between two successive discharges, which provides the 'seed charges' for reignition of the filaments. This modeling has revealed significant details of the discharge behaviors, which greatly improved our understanding of DBD mechanisms.

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