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P4.3006 PIC/Monte Carlo Simulation of Dielectric Barrier Discharge in Argon Plasma at atmospheric pressure

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Interest in dielectric barrier discharges (DBD) for plasma actuators has seen an important growth in the last years. A barrier discharge occurs when an alternating high voltage is applied to conductive electrodes, at least one of them covered with a dielectric layer, allowing only the passage of the displacement current. One-dimensional models for the dielectric barrier discharge dynamics are based on the numerical solution of the electron and ion continuity and momentum transfer equations coupled to Poisson equation. Particle-In-Cell (PIC) simulations take into account the detailed kinetic behavior of charged particles, which is not achievable in fluid simulations [1]. The present work deals with the study of plasma behavior in a parallel-plate dielectric barrier discharge (DBD) by a one-dimensional particle-in-cell/Monte Carlo collision model in argon, at atmospheric pressure. The top dielectric plate is bounded by a planar metal electrode and the bottom dielectric boundary is connected to the grounded electrode. In the model, electron-neutral collisions, both elastic and inelastic, have been considered. In particular, superelastic collisions and electron impact ionization have been accounted for [2]. In the Poisson solver, the surface charge accumulation on all dielectrics are included by selfconsistently accounting for the deposited surface charges, as well as the dielectric coefficients. Moreover, perfect dielectrics have been considered with null conductivity and no charge leaking. The kinetic model has been coupled self-consistently with a proper electric circuit model. Results show the effect of superelastic collisions on the discharge and, in particular, on the electron energy distribution function which is typically calculated by considering inelastic collisions only with ground state neutrals.

References

[1] E. Boella, G. Coppa, A. D'Angola, B. Peiretti Paradisi, Computer Physics Communications 224, 136 (2018)
[2] G. Colonna, G. D'Ammando, L.D. Pietanza, Plasma Sources Science and Technology 25, 054001 (2018)

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