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Fluid modeling of streamer inception and propagation in single-filament dielectric barrier discharges M. M. BECKER, H. HÖFT, M. KETTLITZ, D. LOFFHAGEN, Leibniz Institute for Plasma Science and Technology (INP) — A single-filament dielectric barrier discharge (DBD) at atmospheric pressure (0.1 vol% O_2 in N_2) is investigated with special focus on the inception and propagation of the positive streamer for different pre-ionization levels. The DBD has a gap width of 1 mm and is driven by a 10 kV voltage pulse with a rise time of about 45 ns. The pre-ionization can be adapted, e.g., by the width of the high-voltage pulse. The numerical analysis is based on a spatially two-dimensional axisymmetric fluid model using the local mean energy approximation for the determination of the electron transport coefficients as well as the rate coefficients for elastic and various inelastic collisions. Besides Poisson's equation, balance equations for electrons, heavy particle species and surface charges accumulated on the dielectric surfaces are included. The modeling results are in fair agreement with electrical measurements and provide detailed insights into the Townsend pre-phase, streamer-driven breakdown and subsequent transient glow-phase. It was found that the combined effect of volume and surface charges induces a distortion of the electric field in the pre-phase and results in a reduction of the streamer propagation velocity for pre-ionization levels $\gg 10^{10}\,\mathrm{cm}^{-3}$.

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