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Numerical Simulations of Atmospheric Pressure Discharge using Three-dimensional Fluid Model MUHAMMAD M. IQBAL, MILES M. TURNER, NCPST, DCU — We elaborate the three-dimensional numerical simulations of uniform and filamentary atmospheric pressure discharge in the parallel-plate dielectric barrier geometry with symmetric boundary conditions. The analysis of spatio-temporal species distribution demonstrates that the different discharge regimes are distinguished with their distinctive properties in the uniform glow and filamentary discharges. The spatial profile of electron density along with surface charge density enhances the understanding of a breakdown pulse for the quarter of a cycle. The temporal evolution of current density exhibits that it increases from 20 to 50 KHz, start decreasing and follows an approximate stable path at higher frequencies. The emergence of filaments is analyzed in the lower frequency regime, which explains the precise internal details of their temporary shapes and patterns during the growth and decay phases of filamentary atmospheric pressure discharge. The noticeable structures of filaments are marked at lower frequencies prominently than higher frequencies because the filaments coalesce and form a uniform distribution of discharge plasma at higher frequencies. The movement of filaments is examined with the slice distributions of electrons, which illuminate the path and constricted part of electron density inside the filaments.

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