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INFLUENCE OF DIFFERENT REPETITIVE UNIPOLAR NANOSECOND PULSE EXCITATIONS ON MULTIPLE-CURRENT-PULSE BEHAVIORS AND SPATIAL MODES IN AN ATMOSPHERIC HELIUM DIELECTRIC BARRIER DISCHARGE[¯]

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Dielectric barrier discharges (DBDs) has demonstrated promising application potential in many fields, including energy conversion , material processing, pollution control, and bio-medicine, etc [1,2]. By controlling operating parameters, DBDs driven by a nanosecond pulse (PDBDs) can display different spatiotemporal discharge characteristics, including multiple-current-pulse (MCP) behaviors and abundant spatial modes [3,4]. Therefore, studying the influence of operating application parameters on MCP phenomenon and putting forward the method to eliminate MCP phenomenon have always been an important research to improve the discharge uniformity of DBDs [5]. In our work, we report a systematic numerical study regarding the effect of different repetitive unipolar nanosecond pulse excitations on the MCP behaviors and spatial modes in an atmospheric helium dielectric barrier discharge by using one-dimensional fluid models. The results indicate that the MCP phenomenon exists in both rectangular pulse dielectric barrier discharge (RPDBD) and Gaussian pulse dielectric barrier discharge (GPDBD), and the behavior of MCP leads to axial electron density stratification. While with the same average input power, the MCPs discharge behavior of RPDBD and GPDBD are different, and the current pulse number of the total current in GPDBD is less than that in RPDBD. Further analysis reveals that the above-mentioned difference in MCP discharge performance is caused by the different rise rates of the two pulse voltages. Therefore, the performance of the MCP discharge behavior of the plasma can be affected by adjusting the pulse voltage rise rate, thereby improving the electron density axial distribution in the narrow pulse dielectric barrier discharge. The result of this work is expected to help realize discharge mode manipulation and discharge stabilization in industrial application scenarios.

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