Dielectric barrier discharge in the pin-to-plate configuration: The role of volume and surface effects

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Dielectric barrier discharge (DBD) are self-sustaining electrical discharges in electrode configurations containing an insulating material in the discharge path [1]. When the discharge operates, the barrier surface is charged, which leads to a decrease in the electric field in the gap and the stopping of the discharge current. It has been shown in a number of works [2] that the development of a DBD in some configurations is in many ways similar to the development of a corona discharge, which is determined by the dynamics of the volumetric ion charge at the cathode tip.

The purpose of this work is to study the operation modes of a DBD in a pin-to-plane configuration in air at atmospheric pressure. It was shown that the discharge can develop in four main modes: Trichel pulses, a continuous glow form of the discharge, a cathode-directed streamer starting from the tip and starting from the charged barrier surface. As the gap decreases, a transition occurs from the corona type of discharge to the surface barrier type, which is clearly visible from the change in the characteristics of individual microdischarges and their statistics. The size of the discharge gap at which significant changes occur is approximately 200 μm, which corresponds to an estimate of the size of the cloud of ionic charge formed at the pin during the development of the discharge.

[1] Kogelschat U, Eliasson B and Egli W 1997 *J. Phys. IV* **7** 47–66
[2] Xia Q, Zhang Y, He F, Qin Y, Jiang Z and Ouyang J 2018 *Phys. Plasmas* **25** 023506