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Developments and Interactions of the Channels in Surface Dielectric Barrier Discharge

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The characteristics and developments of surface dielectric barrier discharge (SDBD) channels are significant to control the plasma distribution of SDBD. In this study, the developments and interactions of the discharge channels of ns-pulsed SDBD under different configurations were investigated.

In the discharge images of annular SDBD under single pulse, several obvious separated filaments with a random distribution along the edge of the HV electrode are observed, but there are only quasi-diffuse micro-channels in the high-speed-camera results under 100 ns exposure time. So, an annular SDBD with a serrate edge is applied, whose serrations could control the spots where filaments happen. From the image of single pulse, there are still several filaments ignited from each serration, developing to the center of the circle, and with different bifurcation patterns. Each filament is restrained by their neighbors, and the restraint interaction comes to be aggravated as the number of tips increases. However, if an exposure time of 1 s is adopted, which means 1000 discharges are added together, the distribution of plasma seems so regular and beautiful: no filament could be seen, and the boundaries between different discharge areas are so distinct.

Therefore, an oblique dual-tip configuration of SDBD is brought up to deeply investigate the dynamic evolutions and physical mechanisms of interactions among the discharge channels. The interactions between channels are observed to be influenced by the tip angle. For electrode with small angles (30-90°), the channels exhibit a clear mutual repulsion, which is intensified by a higher voltage. When the angle increases to 120°, the gap between the two tips happens to be bridged. With the high-speed images, it is found that the channel evolution displays typical three stages: firstly, the two channels develop independently, and then they merge and interconnect. At last, the interconnected channel extends along a specific direction to form a dominant single channel, which eventually branched at its leading edge.

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References

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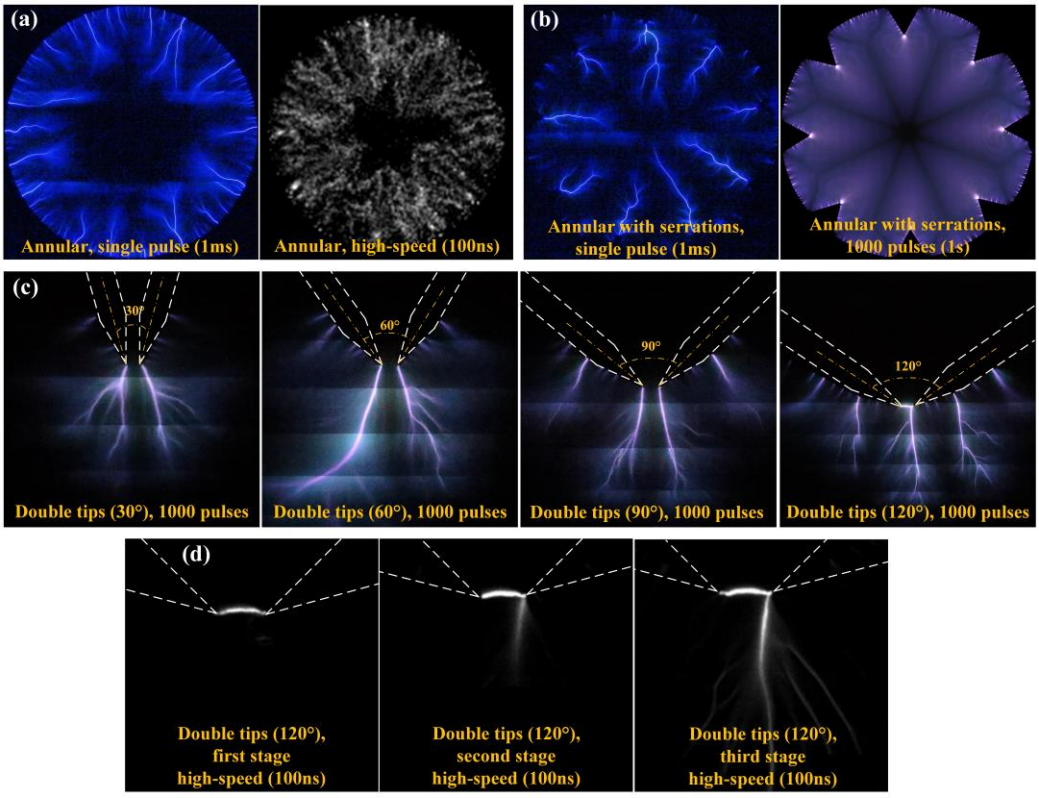

Figure 1. Discharge images of various SDBD, (a) images of annular SDBD under single pulse and high-speed, (b) images of annular with serrations under single pulse and high-speed, (c) images of oblique dual-tip SDBD of 1000 pulses under different tip angles, (d) typical three stages of oblique dual-tip SDBD with a 120° tip-angle.