8th Asia-Pacific Conference on Plasma Physics, 3-8Nov, 2024

Developments of Surface Dielectric Barrier Discharge Channels under AC and Nanosecond Pulse Excitations

Hui Jiang[1], Jinyu Tang[1], Yufei Han[1]

[1] National Key Laboratory of Power Transmission Equipment Technology, School of Electrical Engineering, Chongqing University

e-mail (speaker): jianghui@cqu.edu.cn

The characteristics and developments of surface dielectric barrier discharge (SDBD) channels are significant to control the plasma distribution of SDBD. In this paper, the developments and interactions of the discharge channels of SDBD under ac and ns-pulsed excitations were studied. A single tip-strip SDBD structure was designed to produce a single-channel, and a structure of two tips facing obliquely was to get double-channels' interaction. Besides, an annular SDBD with a multi-tip HV edge could result in interactions of multi-channels, and 12 and 48 tips were adopted, which could represent sparse and crowded distributions of discharge channels, respectively. Experimental results show that under the ac power supply, regular and separated discharge channels are ignited from each tip, and the intensity and size decrease as the number of the tips increase. The two channels from the double-tip actuator repel each other obviously. Under the multi-tip actuators, a series of short and slender discharge channels develop to the center of the circle, and each channel is restrained by the neighbouring channels, and the restraint interaction comes to be aggravated as the number of tips increases. For example, the 12 channels are still discriminable under the 12-tip annular SDBD, while the discharge presents diffuse without obvious channel under the 48-tip condition. The restraint interactions of the channels also happen in the discharge under the ns-pulsed power supply. However, another important feature of the discharge channels under the ns excitation is bifurcation. In the single channel, the bifurcation seems to be random, free and repeated occurs. Due to the repelling between the channels under the discharge of double-tip condition, the bifurcation only happens at the outside of the channels, and the gap of the two channel is larger than that under the ac excitation. Nevertheless, owing to the sparse distribution of the 12 tips in the annular SDBD, the bifurcated discharge channels from the tips are similar to the result of single tip, but the average length and the shape of the front of the channels are different. Moreover, at the 48-tip condition, the bifurcation mainly occurs at the head of each channel, and distinctly from the diffuse discharge of ac SDBD, there are 48 channels with a regular distribution of a long channel alternated with a short channel. In conclusion, the development characteristics of the discharge channels in SDBD are important to the formation of the plasma distribution and regulation.

This work is funded by National Natural Science Foundation of China, grant number 52377135.

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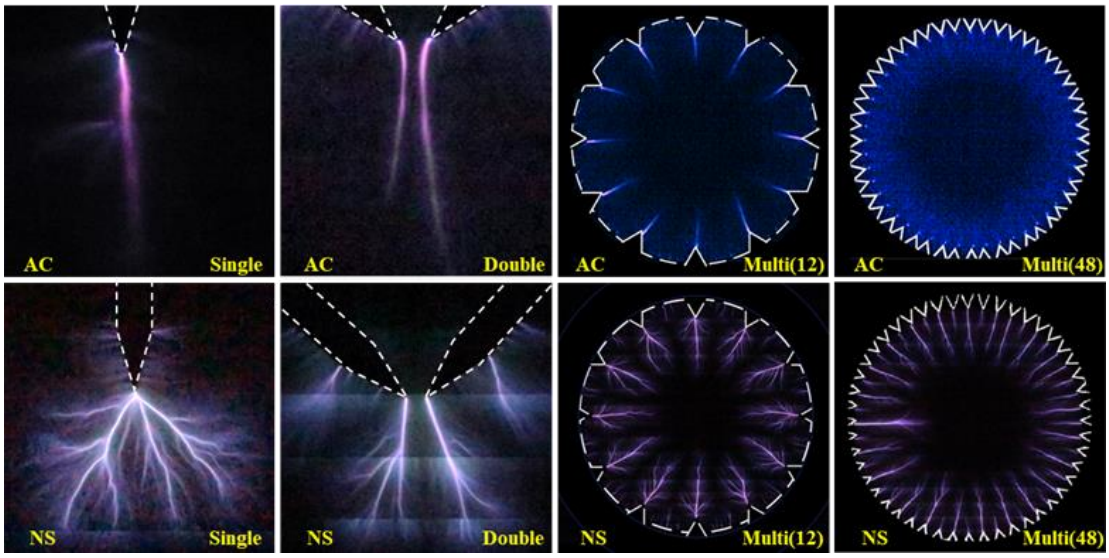

Figure 1. Discharge channels of SDBD with tips under ac and nanosecond pulse excitations.