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The modification of EP/AlN Composites by Rotating DBD

Jiang Nan*, Yu Guanglin and Li Jie
School of Electrical Engineering, Dalian University of Technology, Dalian, China
e-mail: jiangnan@dlut.edu.cn

Dielectric Barrier Discharge (DBD) plasma modification is crucial for enhancing the surface insulation performance of epoxy resin composites. However, achieving uniform modification at atmospheric pressure remains a significant challenge. The impact of the rotating dielectric plate on the characteristics of plate-plate DBD was investigated via experiments and CFD simulations. The results demonstrate that the rotating dielectric plate significantly enhances DBD power and macroscopic uniformity. In contrast to 0 revolutions per second (rps), at 50 rps, the discharge power increases by 49%, and the gray standard deviation of discharge images reduces by 41%. The alteration in microdischarge locations is the primary factor contributing to the enhanced macroscopic uniformity. In S-DBD, the majority of microdischarges persistently occur at the same spot due to the "memory effect." Rotating the dielectric plate modifies the position of the surface charge in different discharge cycles, thereby facilitating the generation of discharges at novel locations through its field enhancement effect. As a result, R-DBD is capable of breaking the "memory effect" and extending the spatial distribution of microdischarges. The airflow produced by the rotating dielectric plate expedites the transportation of residual ions, providing seed electrons for a wider discharge area and further promoting the expansion of the spatial distribution of microdischarges. Additionally, surface modification of epoxy resin/aluminum nitride composites was achieved using atmospheric pressure DBD, and the discharge characteristics and modification effects were evaluated. The findings show that the surface conductivity, flashover voltage, and wettability of the plasma-modified materials gradually increase with longer treatment time. Although the modification effect of static DBD in local areas is better than that of rotating DBD, the uniformity of modification in rotating DBD is much higher. Compared to S-DBD modified samples, the interquartile range increment of surface flashover voltage for R-DBD modified samples decreases by 40%.

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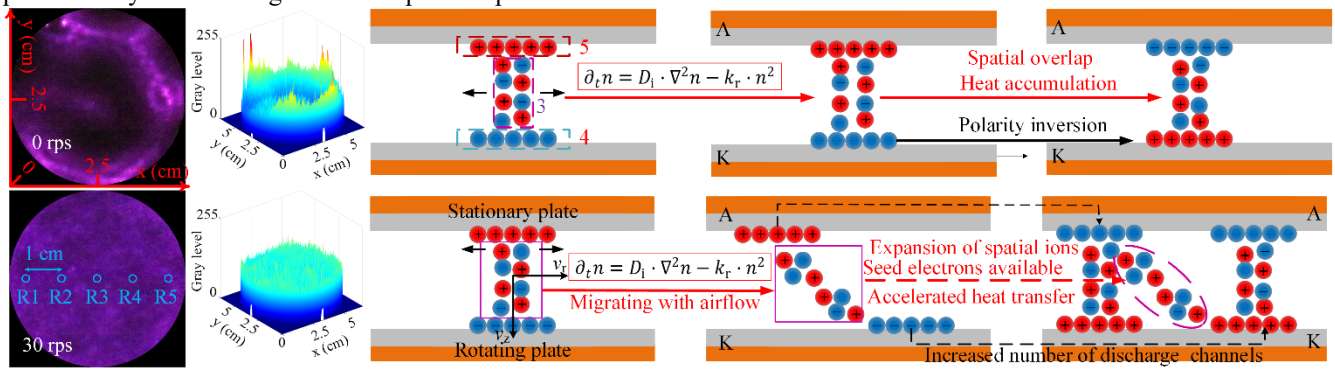

Effects and mechanisms of rotating dielectric plates on DBD characteristics