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# Insight into the fundamental characteristics of micro-APGD below 100 µm

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The atmospheric glow discharge at microscale (micro-APGD) has shown great applications in biomedicine, materials modification, micro propulsion and film deposition, etc. due to the high energy density, low power consumption and good operability in various atmospheric environments. Therefore, it is very essential to understand the fundamental characteristics of micro-APGD with the feature dimension lower than 100 µm. This work presents the glow discharge behaviors and influence mechanism across an atmospheric air gap ranging from 10 µm to 600 µm, emphasizing the insight into the discharge mode transition and microplasma characteristics below 100 µm.

Results show that when gap width is less than 20 µm, the streamer corona discharge mode can be observed as the discharge transits from corona discharge to stable glow discharge in the air, which could only be reported in Ar or He atmosphere. As the gap width decrease from 600 µm, the Faraday dark region behaves with a same trend and the anode region seems very thin till both regions completely disappear when gap width reduces to 40 µm. At the same time, the cathode region remains constant as well as the gap voltage. The simulation results illustrate that the major voltage drop lies in the cathode region, which could explain the independence of the Faraday dark region from the gap voltage. During the APGD process, the discharge I-V curves also demonstrates a transition that the gap voltage increases with the discharge current when the gap width larger than 60 µm, then transits to a constant current when the gap width decreases to 40 µm or lower. In summary, we discover a significant size effect of the APGD plasma at microscale, and the gap width threshold is about 40 µm for the hemisphere-hemisphere discharge structure in our work.

## References

[1] G. Meng, Q. Ying, et al. The influence of the cathode radius on the microgap breakdown in air based on PIC/MCC simulation, IEEE Conference on Electrical Insulation and Dielectric Phenomena (CEIDP), 2019.

[2] Garner, A. L., Meng, G. et al. Transitions between electron emission and gas breakdown mechanisms across length and pressure scales. Journal of Applied Physics, 128(21), 210903, 2020

[3] Zezhou Chang, Study on characteristics of atmospheric low temperature microplasma and jet with scale of 10~200 µm[D], Xi'an Jiaotong University, Xi'an, 2022

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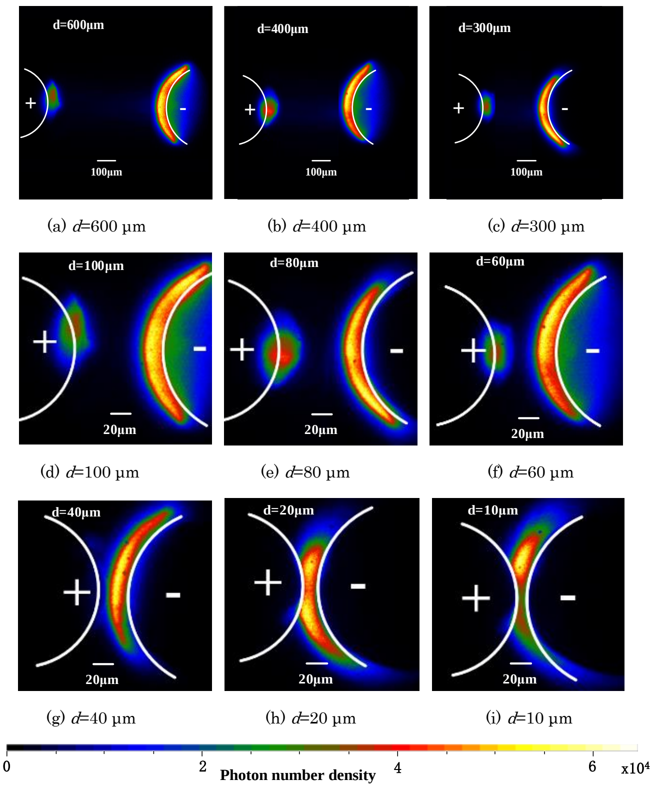


Figure.1