

A 10-cm long atmospheric pressure filamentary discharge produced in helium spiral vortex

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The lightning discharge, corona discharge, streamer discharges, dielectric barrier discharge, and atmospheric pressure plasma jet are the typical examples of atmospheric pressure plasma. By taking the advantage of the aerodynamic property to produce localized gas structure, manipulating the shape of the discharge becomes a possible work. We produced a ring-shaped plasma in a circular helium gas vortex in open air in 2016 ^[1]. The gas vortex ring plays the role of plasma chamber but without a solid boundary. In 2020 we showed that the discharge produced by Tesla coil propagates in a prebuild gas channel, even the gas channel is strongly bended ^[2].

Here, we report the generation of long plasma filament confined in a helium spiral vortex at atmospheric pressure ^[3]. The discharge is produced by a dielectric barrier discharge setup and confined in the center of spiral vortex. The length of the discharge can be several centimeters and maintained at flow rate less than 1 SLM. We find that the long filamentary discharge is the trajectory of repeatedly fast-traveling plasma bursts and plasma plumes, which is similar to the atmospheric

pressure plasma jet. The speeds of the downstream and upstream plasma bursts are about 46000 and 95000 m/s, respectively, which are affected by the spirally upward helium gas flow. Based on the novel design of vortex-confined discharge, we show that a plasma filament with length of 10 cm can be produced. This work was supported by the National Science and Technology Council, Taiwan (Contract No. MOST 108-2112-M-194-004-MY3).

References

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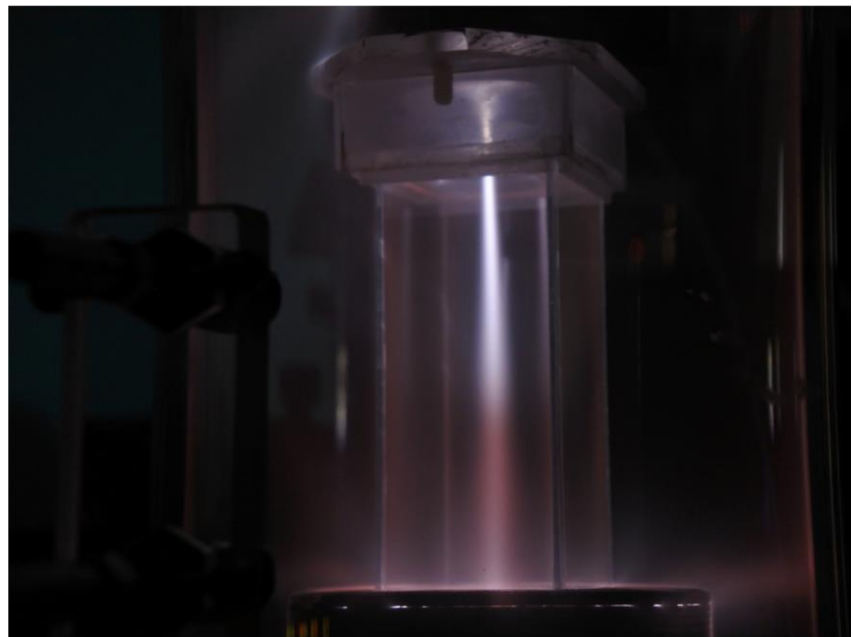


Figure 1. The spiral vortex inside the cell is visualized by the water mist. Exhaust fan, buffer tank, square cell, and flow vanes are sequentially shown from the top to the bottom (left). A 10-cm filamentary discharge is produced at 29 kVpp (right).