Segmented high voltage glow discharge for a controllable ion source

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A novel cylindrical ion source has been developed in order to produce an ion source, whose intensity can be easily controlled in each segment. It is possible to independently ignite each segment and, consequently, an inhomogeneous ion beam with the desired intensity can be extracted. Due to the wire anode configuration an electrostatic trap is built, within discharge electrons perform rosette orbits. This set up improves the electron lifetime and, accordingly, the ion production is enhanced which allows the discharge to be sustained down to 1 Pa. Finally, ions scape from the discharge through the extraction grid. In this contribution the latest investigations in a single plasma discharge segment will be presented.

1. Chamber geometry

The plasma chamber consists of two concentrically cylinders, the external one is a grid. Each section is defined by the volume included by two plates, which are built in perpendicular to the surface of both cylinders and in parallel to the radial axis. The plasma discharge is typically divided in five segments. The aforementioned structure is at ground potential. The anode is a tungsten wire built in parallel to cylinder´s axis of symmetry.

2. Segmented discharge

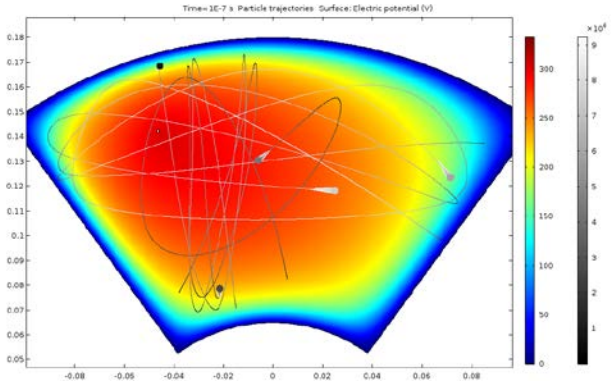

Fig 1. One segment discharge simulation. The colour scale represents the electric potential created by the discharge (max. 350 volts). The greyscale represents the discharge electron velocity (max. 9 10^6 m/s).

The segmented wire anode discharge developed by Fraunhofer FEP is based on McClure´s glow discharge [1]. The anode wire electric potential creates an electrostatic trap, which enhances the electron lifetime and, consequently, the ion production [2]. In Figure 1 discharge electrons movement inside the electric field, created by the plasma, is simulated. In Figure 2 is a picture of the experimental set up discharge. In Figure 3 ignition curves of a single segment are shown using helium and argon as working gas.

Fig 2. Picture of a single segment discharge experimental set up, with argon as working gas.

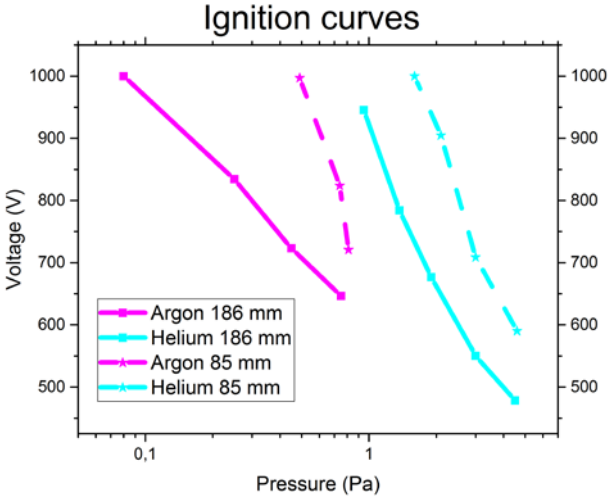

Fig. 3. Single segment ignition curves for argon and helium with two different chamber heights.

3. References

[1] G. W. McClure, “Low-pressure glow discharge” *Applied physics letters* ***2****, 12,* (1963).

[2] Makarov. “Why does a low-pressure wire-discharge exists self-sustained?” *Europhys. Lett, 74(3), 2006*